

FISHERY RESEARCH



Job Performance Report
Project F-73-R-16

HATCHERY TROUT EVALUATIONS

Subproject V, Study I



Job 2. Effects of Fish Size, Hook Size, and Angler Distribution

by

Gregg Mauser
Senior Fishery Research Biologist

IDFG 94-34
December 1994

TABLE OF CONTENTS

	<u>Page</u>
ABSTRACT	1
INTRODUCTION	3
GOAL	3
OBJECTIVES	3
METHODS	4
Number and Size of Fish	4
Angler Distribution	9
Hook Size	9
RESULTS	9
Number and Size of Fish	9
Angler Distribution	11
Hook Size	20
DISCUSSION	20
Number and Size of Fish	20
Angler Distribution	28
Hook Size	29
RECOMMENDATIONS	30
ACKNOWLEDGEMENTS	31
LITERATURE CITED	32
APPENDICES	35

LIST OF TABLES

Table 1. Stocking schedule for jaw-tagged hatchery rainbow trout, Wood River study streams, 1993	7
Table 2. Distribution of anglers (%) in relation to Wood River stream sites stocked with hatchery rainbow trout in 1993. Stocked areas were within 0.2 km of stocking sites	17

LIST OF FIGURES

	<u>Page</u>
Figure 1. Map of the Wood River drainage near Ketchum, Idaho showing sites stocked by Hayspur Fish Hatchery personnel and stream sections used to compare releases of 24 cm and 30 cm hatchery rainbow trout in 1993	5
Figure 2. Length-frequency distribution of marked hatchery rainbow trout stocked in Wood River streams in 1993	6
Figure 3. Weekly returns (%) of jaw tags from 30 cm and 24 cm put-and-take trout stocked in sections of Warm Springs Creek, Trail Creek, and the upper Wood River in 1993	10
Figure 4. Weekly returns (%) of jaw tags from 30 cm and 24 cm put-and-take trout stocked in Wood River study streams in 1993. . . .	12
Figure 5. Ratios of jaw tag returns from 30 cm and 24 cm hatchery rainbow trout stocked in Wood River study streams in 1993	13
Figure 6. Angler ratings (1 = worst, 10 = best) of fishing quality on sections of Trail Creek and Warm Springs Creek stocked with marked put-and-take trout in 1993	14
Figure 7. Angler ratings of fishing quality for Wood River study streams and corresponding stocking densities for unmarked hatchery rainbow trout (number per hectare)	15
Figure 8. Preferences (%) for one 30 cm fish or two 24 cm put-and-take trout expressed by anglers fishing Wood River streams in 1993	16
Figure 9. Map of Warm Springs Creek showing angler distribution (N = 291) in relation to stocking sites within study sections	18
Figure 10. Map of Trail Creek showing angler distribution (N = 238) in relation to stocking sites	19
Figure 11. Map of upper Wood River showing angler distribution (N = 139) in relation to stocking sites within study sections	21
Figure 12. Hook sizes used (%) by anglers fishing with bait, and catch rates (fish per hour) in relation to hook size for Wood River streams in 1993	22
Figure 13. Hook sizes used (%) by anglers fishing with flies, and catch rates (fish per hour) in relation to hook size for Wood River streams in 1993.....	23

LIST OF FIGURES (continued)

	<u>Page</u>
Figure 14. Hook sizes used (%) by anglers fishing with bait, and catch rates (fish per hour) in relation to hook size for Gavers Lagoon in 1993)	24
Figure 15. Hook sizes used (%) by anglers fishing with flies, and catch rates (fish per hour) in relation to hook size for Gavers Lagoon in 1993	25

LIST OF APPENDICES

Appendix A. Number and size of unmarked hatchery rainbow trout stocked in Wood River study streams in 1993	36
Appendix B. Tag return instructions attached to boxes at stocking sites on three streams in the Wood River drainage in 1993.....	37
Appendix C. Tag return instructions attached to sign posts in sections stocked with hatchery rainbow trout in 1993	38
Appendix D. Angler counts and estimated angling effort (hours) for censused sections of Warm Springs Creek in 1993	39
Appendix E. Angler counts and estimated angling effort (hours) for censused sections of Trail Creek in 1993.....	40
Appendix F. Angler counts and estimated angling effort (hours) for censused sections of the upper Wood River in 1993	41
Appendix G. Photocopy of rainbow trout print used to ask whether anglers preferred to catch one 30 cm fish or two 24 cm fish.....	42
Appendix H. Weekly tag returns (unadjusted) for two size groups of hatchery rainbow trout stocked in Warm Springs Creek in 1993	43
Appendix I. Weekly tag returns (unadjusted) for two size groups of hatchery rainbow trout stocked in Trail Creek in 1993.....	44
Appendix J. Weekly tag returns (unadjusted) for two groups of hatchery rainbow trout stocked in the upper Wood River in 1993.....	45
Appendix K. Weekly tag returns (unadjusted) for two size groups of rainbow trout stocked in Wood River streams in 1993	46
Appendix L. Return rates for tagged rainbow trout stocked in Wood River streams in 1993	47

JOB PERFORMANCE REPORT

State of: Idaho

Name: Hatchery Trout Evaluations

Project: F-73-R-16

Title: Effects of Fish Size, Hook
Size, and Angler Distribution

Subproject: V

Study: I

Job: 2

Period Covered: April 1, 1993 to March 31, 1994

ABSTRACT

Anglers returned 1.2 times as many jaw tags from 30 cm (large) compared to 24 cm (small) hatchery rainbow trout Oncorhynchus mykiss stocked in three streams in the Wood River drainage in 1993. Estimated returns of 51% for large fish and 41% for small fish from all streams combined were significantly different ($P = 0.05$). Differences were greater (48% and 29%) considering angler effort in the immediate vicinity of stocking sites. Differences in adjusted rates were highly significant ($P = 0.01$). A given hatchery capacity can rear half the number (same weight) of large fish compared to small hatchery rainbow trout. If unadjusted returns were representative of other Idaho streams, stocking large fish would result in a 38% reduction in number of put-and-take trout harvested. Fewer, larger fish may be acceptable considering almost twice as many anglers fishing Wood River streams preferred to catch one large rather than two small hatchery trout ($P < 0.005$). Where on-site effort was nearly equal, anglers harvested large fish sooner after stocking. Relative catchability and benefits of stocking larger fish thus may be somewhat greater than demonstrated by season-long returns. Based on work in Minnesota, stocked fish should be at least 23 cm long to be acceptable to anglers.

The majority of anglers (78%) fished the vicinity of stocking sites, possibly because both stocking and effort were associated with roadside access. Anglers also fished 0.2 km or farther from stocking sites, still mostly within sight of roads. They fished downstream portions of study areas most intensively. Anglers concentrated at the first readily accessible areas they encountered when driving from the town of Ketchum. The most heavily fished area on Warm Springs Creek was lightly stocked. It may be useful to map angler use and adjust stocking locations for the stream stocking program in Idaho. Cost effectiveness of changing stocking locations should be compared to programs to direct anglers to stocked areas.

Census clerks asked anglers to rate the quality of fishing on a 1-10 scale from poor to excellent to determine possible effects of stocking fewer, larger fish. Mean ratings of fishing quality were similar for sections stocked with large and small tagged fish. To avoid changing angler use, however, normal stocking of study streams proceeded with 20,000 unmarked fish approximately 25 cm total length. Since large fish made up a minor portion of total stocking and

harvest, fishery ratings would not be expected to differ within streams. There were differences ($P < 0.005$) between individual streams. Mean ratings of 5.6 for Warm Springs Creek, 6.3 for the upper Wood River, and 7.1 for Trail Creek corresponded with stocking densities of 349, 459, and 4,261 unmarked hatchery rainbow trout/ha, respectively.

To examine possible relationships between hook size and angler success, census clerks recorded hook use and catch rates for anglers fishing study streams and a pond fishery. Hook size was related to catch rate only for anglers using bait in the pond fishery. Catch rates increased from less than one to better than five fish per hour as hook size decreased. Angling skill may have confounded this result.

Author:

Gregg Mauser
Senior Fishery Research Biologist

INTRODUCTION

Harvest of 40% of stocked trout and angler success of 0.5 fish/h are guidelines for efficient returns on license dollars and satisfactory put-and-take fishing for Idaho anglers (IDFG 1991; Mauser 1994). Put-and-take harvests are determined primarily by fishing effort (Cooper 1959). Stocking sites will support better harvests if hatchery fish are highly catchable. Catchability depends mainly on the fish and the environment they are stocked into (Butler and Borgeson 1965). I examined three factors which might be managed to improve catchability in stream stocking programs for put-and-take trout.

Catchability increases with fish size (Mullan 1956; Potter and Barton 1986). Census estimates and tag returns from Rock Creek south of Twin Falls, Idaho indicated 34 cm stocked rainbow trout Oncorhynchus mykiss returned to anglers 1.8 times as often as 22 cm fish (Mauser 1992). Management techniques that can nearly double return rates have considerable potential to improve program efficiency and angler satisfaction. I sought additional information on the use of fish stocked at larger than normal size to benefit put-and-take trout fishing. I wanted to know if increased returns occurred in other stream systems and for fish sizes that could be raised in large numbers. I also was interested in the effect of stocking fewer, larger fish on fishing quality.

A related question concerns size of hooks used by anglers to most effectively catch hatchery trout. Investigators have found smaller hooks capture more fish (Hulbert and Engstrom-Heg 1980; Oral. 1987; Ralstrom 1990). This effect is often associated with fish size. We wanted to know if catchability of stocked trout could be improved simply by changing hook sizes.

I also examined potential effects of angler distribution on harvest of hatchery rainbow trout. I wanted to know if anglers fished sites stocked in established hatchery programs. Rohrer (1987) found return rates of put-and-take rainbow trout were related to fishing pressure on Henry's Fork of the Snake River, Idaho. Bailey (1974) indicated anglers concentrated near stocking sites on West Virginia streams even though stocked trout moved downstream. The majority of fish available for harvest in Salmon River, Idaho streams remained in the vicinity of stocking sites (Mauser 1994). If anglers fail to fish stocking sites or to locate fish, benefits of stocking could be reduced.

GOAL

To increase catchability and return-to-creel of put-and-take trout in streams.

OBJECTIVES

1. To determine effects of stocking fewer, larger fish on return rates and angler satisfaction in put-and-take stream fisheries.

2. To assess angler distribution in relation to stocking sites and explore methods for increasing angler utilization of hatchery reared fish.
3. To determine if catchability and returns of hatchery trout could be improved by angler use of certain size hooks.

METHODS

Number and Size of Fish

We stocked marked fish in three streams in the Wood River drainage near Ketchum, Idaho for size comparisons in 1993 (Figure 1). On each stream, I selected two sites normally stocked by Hayspur Fish Hatchery personnel as the basis for study sections. Stocking sites for test fish were at least 4 km apart to minimize movement of tagged fish into the adjacent section in each stream. I assigned 30 cm (large) fish to the downstream section of Warm Springs Creek at random, then alternated systematically with large fish in the upstream section of Trail Creek and the downstream section of the Upper Wood River. Small (24 cm) fish were stocked in the remaining study section in each stream.

I used a stocking rate of one large to two small fish to approximate the same production weight and cost of hatchery rainbow trout. I tested a minimum of 244 large fish and 488 small fish in each stream based on unequal sample sizes for proportions (Fleiss 1981). I calculated sample sizes for minimum return rates of 15% for large fish, and 10% for small fish.

Both sizes of fish came from the Idaho Department of Fish and Game (IDFG) Hayspur Fish Hatchery located south and east of Bellevue, Idaho. We graded fish from several raceways by hand to obtain approximately 2,400 fish for the experiments. Large fish averaged 29.9 cm and ranged 28.0-33.6 cm. Small fish averaged 24.0 cm and ranged 22.0-25.3 cm (Figure 2).

We measured fish to the nearest 0.1 cm and marked them with numbered metal jaw tags during loading for transport. I used compressed carbon dioxide to anesthetize fish and hauled them to release sites in a portable wooden tank with compressed oxygen delivered through air stones. Paired sections were stocked the same or following day.

I made weekly releases of 61 large fish and 122 small fish in each stream between July 15 and August 12, 1993 (Table 1). I exchanged stocking sites for large and small fish after half the fish were stocked in upper Wood River sections. Other sites were stocked with marked fish of the same size throughout the study.

Normal stocking of unmarked hatchery fish proceeded at nearby stocking sites. These were fish from the same facility. A total of 4,500 fish (349/ha) averaging 25.1 cm total length were stocked in Warm Springs Creek on three dates during July and August (Appendix A). These fish were stocked at 10 of 12 regular stocking sites (Figure 1). Trail Creek received 6,000 fish (4,261/ha) which

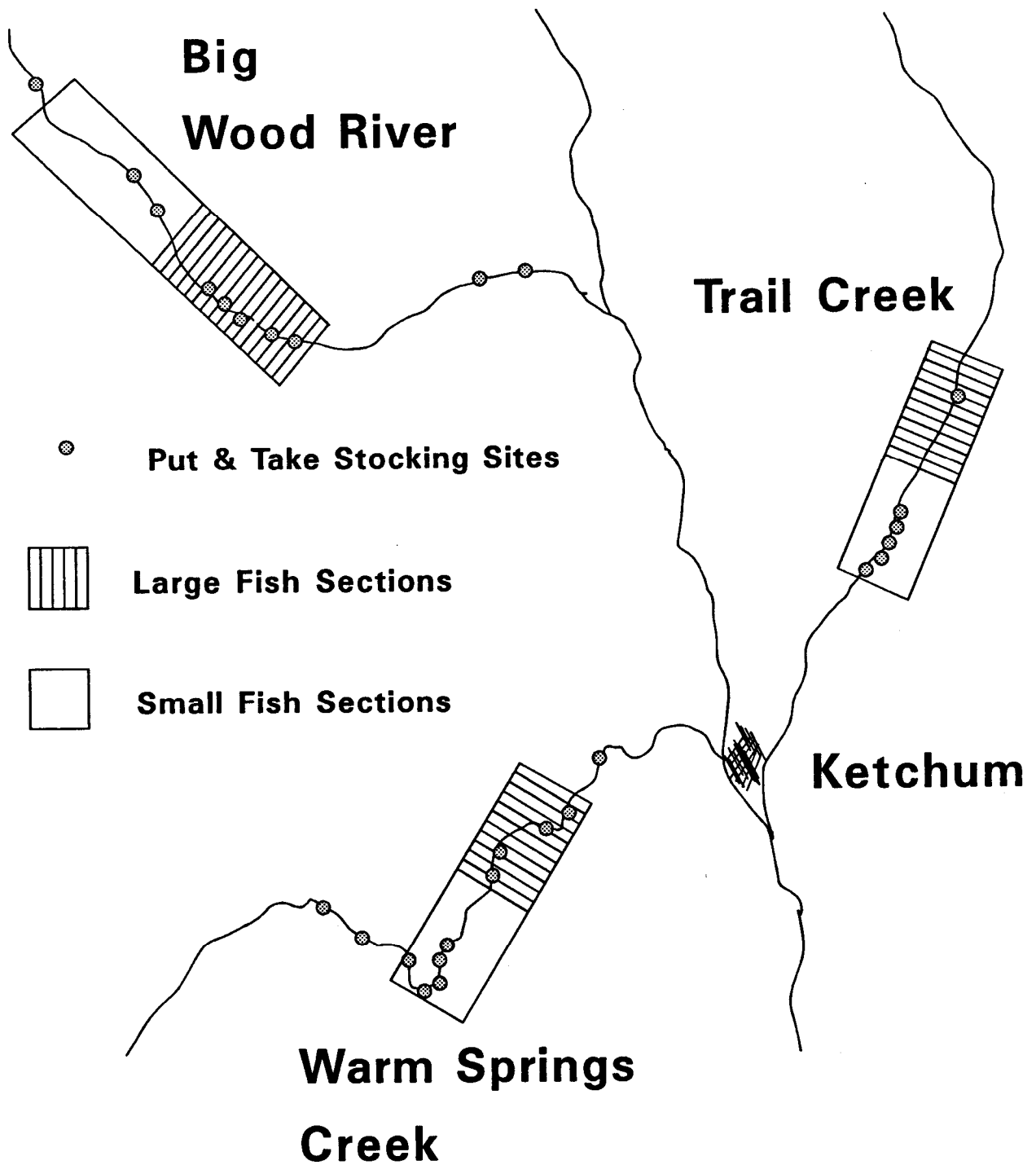


Figure 1. Map of the Wood River drainage near Ketchum, Idaho showing sites stocked by Hayspur Fish Hatchery personnel and stream sections used to compare releases of 24 cm and 30 cm hatchery rainbow trout in 1993.

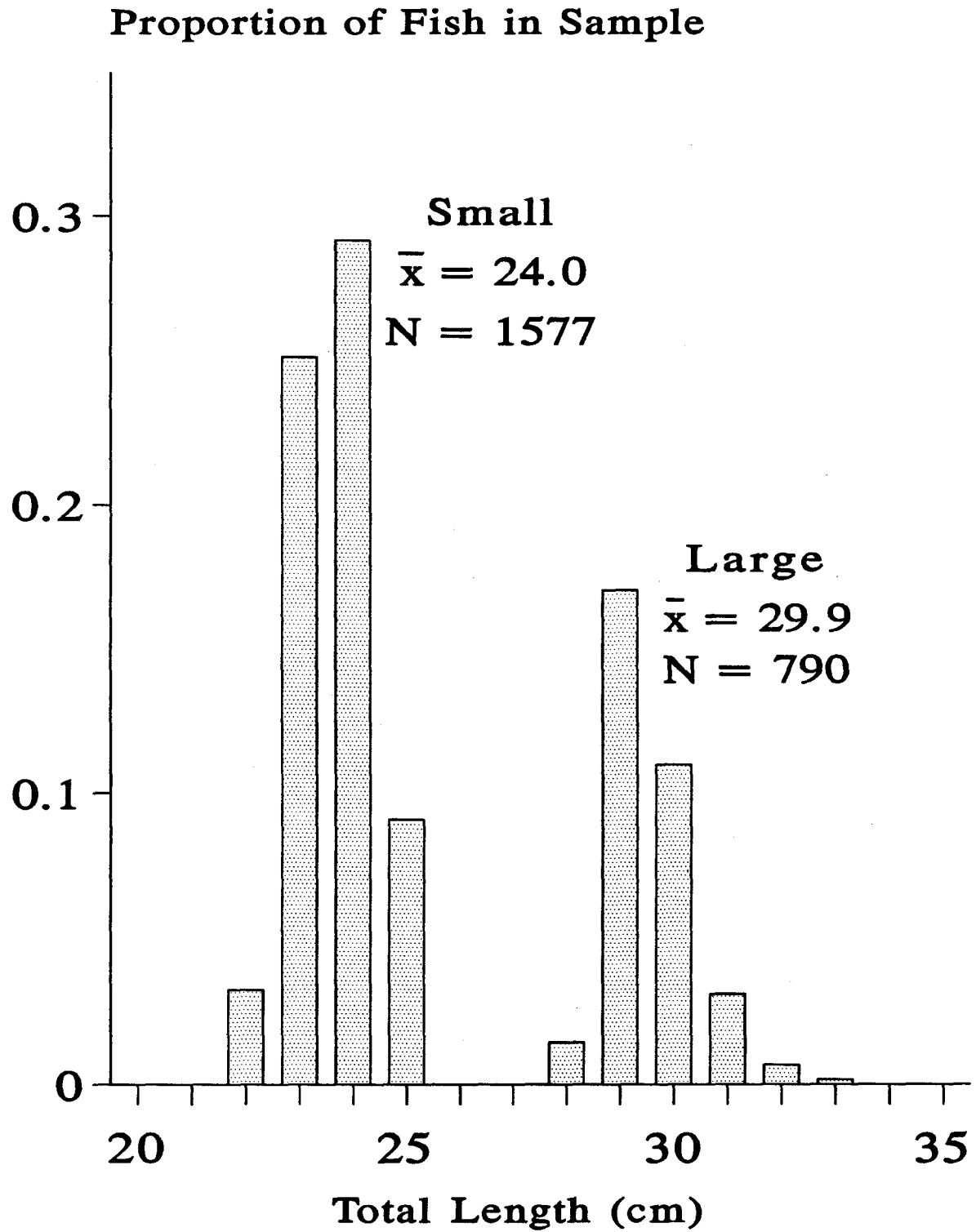


Figure 2. Length-frequency distribution of marked hatchery rainbow trout stocked in Wood River streams in 1993.

Table 1. Stocking schedule for jaw-tagged hatchery rainbow trout, Wood River study streams, 1993.

Stream	Date	Number Stocked	
		30 cm (large)	24 cm (small)
Warm Springs Creek	July 15-16	60	122
	23	61	122
	29	60	122
	August 05	61	122
	12	61	122
	Total	303	610
Trail Creek	July 22	61	123
	28	61	122
	August 04	61	122
	11	61	121
	Total	244	488
Wood River	July 20	61	121
	27	61	121
	August 03	61	122
	10	61	117
	Total	244	481
Grand totals		791	1,579

averaged 25.8 cm and were stocked on four dates. Stocking occurred at four of six regular sites (Figure 1). The Wood River above the North Fork was stocked on six dates between June and September with 9,838 fish (459/ha) which averaged 25.0 cm. Stocking occurred at 8 of 10 regular sites (Figure 1).

We placed a tag return box at each of the six sites stocked with marked fish. Boxes contained envelopes for returning tags. We attached tag return instructions to boxes (Appendix B) and sign boards (Appendix C) located in stocked areas.

Census clerks conducted counts and interviews of anglers fishing within each section stocked with marked fish. Census ran for 10 or 11 weekly intervals from July 17 to October 1, 1993 depending on initial stocking dates (Appendices D-F). Purpose was to estimate relative use, record angler preferences for size of fish, and solicit angler ratings of fishing quality. Angler counts were conducted as often as possible with no randomization of count times. Census clerks were instructed to count each pair of sections when a count was made, and to vary count times and stream sections as much as possible. I used an IDFG creel census program to expand angler counts by daylight hours and estimate relative fishing pressure by weekly intervals (McArthur 1993).

I used the proportion of angler hours in the immediate vicinity of stocking sites to adjust return rates for fishing effort. I sought to remove effort that might not apply to marked fish. Site-specific effort was total hours fished for each section multiplied by the proportion of angler interviews within 0.2 km of marked fish release sites. Since widths were similar within streams I made effort adjustments on a linear basis rather than using surface area. I standardized return rates by multiplying the raw return associated with the highest effort in each stocking pair by the ratio of lessor:greater effort. The result was a reduced rate relative to the unadjusted return for each stocking in the pair that was subjected to more effort. I used paired t tests (Zar 1984) to compare large and small return rates (adjusted and unadjusted) for all streams combined.

I sought to determine if fewer, larger fish affected angler satisfaction, by having census clerks ask anglers to rate fishing quality on the day of the interview. I used a 1-10 scale similar to that recommended by Matlock et. al (1991), with 1 being worst and 10 being best. Anglers were asked to rate fishing quality exclusive of weather conditions, camping facilities etc. This was done to separate fishing satisfaction (number and size of fish caught) from trip satisfaction (overall experience based on other factors) because most anglers rate these two items differently (Spencer and Spangler 1992). We did not specifically ask anglers to address fish size and numbers, only to restrict answers to fishing. I compared the cumulative distributions of responses for large and small fish sections of Warm Springs and Trail Creek with a Two-Sample Kolmogorov-Smirnov Test (Wilkinson 1990). I used a Kruskal-Wallis One-Way Analysis of Variance to test differences in fishing quality among streams.

To obtain information on size preferences in relation to hatchery production capabilities we presented anglers with images of fish identical in size to tagged fish. Census clerks showed anglers photocopied prints (Wiechman 1990) of one large rainbow trout and two small fish and asked which they would rather catch

(Appendix G). I evaluated cumulative percentage responses for large fish with a Binomial Probability Test (Kirby 1993).

Angler Distribution

Census clerks recorded individual angler locations according to reference points on US Geological Survey maps. Angler locations were recorded during interviews conducted over entire study sections.

Hook Size

To examine potential relationships between hook size, fish size, and catch rates, I had census clerks record information on Wood River study streams during the census described above. We also collected hook size information on 25 d between May 29 and September 26, 1993 at a pond fishery for hatchery rainbow trout at Hayspur Fish Hatchery. We measured angler terminal gear against hook charts, recorded catch rates, and measured harvested fish. I compared frequency of use for various hook sizes to catch rates (fish per hour) to see if they were related.

RESULTS

Number and Size of Fish

Unadjusted tag returns averaged 59% of large fish and 45% of small fish stocked in Warm Springs Creek (Figure 3). Large fish generally returned at higher rates in the first 2 weeks, followed by higher returns of small fish in weeks 3 and 4. Most tag returns of both large and small fish occurred within a month of stocking. Where returns were low the first week after stocking, subsequent recoveries tended to be greater (Appendix H). Fishing pressure in the immediate vicinity of stocking sites averaged 275 h (688 h/km) for large fish and 509 h (1,274 h/km) for small fish (Appendix D). Adjusted returns were 59% and 25% considering site-specific effort (Appendix L).

Unadjusted tag returns for Trail Creek averaged 47% for large fish and 26% for small fish (Figure 3). Large and small fish returned at similar rates in the first 2 weeks followed by greater returns of large fish. The last two releases of large fish varied from this pattern. The August 4 stocking returned at low rates throughout. The August 11 release returned primarily in the first week (Appendix I). Site-specific effort was 407 h (1,018 h/km) for large fish and 502 h (1,255 h/km) for small fish (Appendix E). Adjusted returns were 47% and 22% for large and small fish respectively (Appendix L).

Unadjusted tag returns on the upper Wood River averaged 45% for large fish and 51% for small fish (Figure 3). Large and small fish returns were similar but

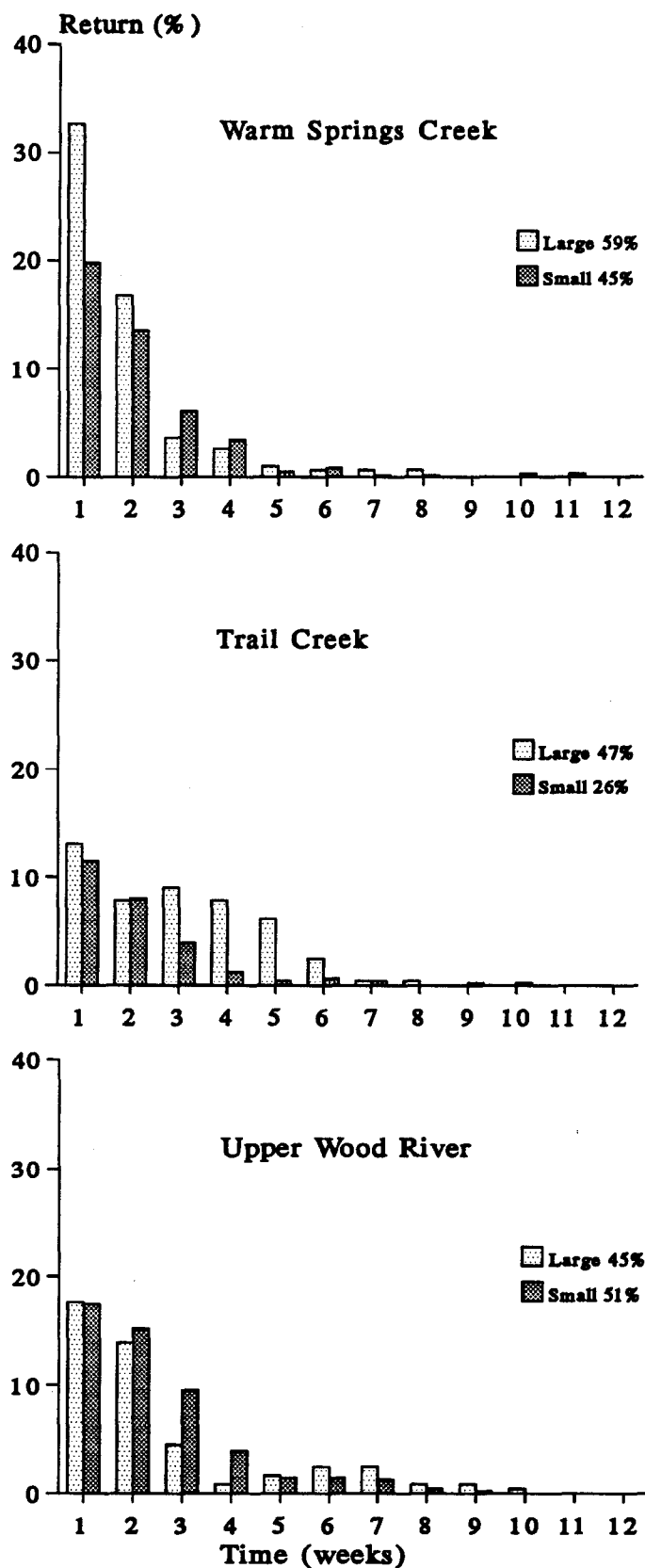


Figure 3. Weekly returns (%) of jaw tags from 30 cm and 24 cm put-and-take trout stocked in sections of Warm Springs Creek, Trail Creek, and the upper Wood River in 1993.

large fish releases varied more (Appendix J). Site-specific effort was 247 h (616 h/km) for large fish and 234 h (586 h/km) for small fish (Appendix F). Since stocking sites were exchanged, fishing pressure for size comparisons was a combination of effort for both stream sections. Adjusted returns were 36% and 41% for large and small fish respectively (Appendix L).

Anglers returned 51% of tags from large fish and 41% from small fish from all streams combined (Figure 4). This difference was significant ($P = 0.05$). Large fish returns were greater than those of small fish in 8 of 11 weeks (Appendix K). Overall tag return ratios were 1.3 and 1.8 times as many large fish on Warm Springs and Trail Creeks and 1.1 times as many small fish for the upper Wood River (Figure 5). Unadjusted returns for all streams were 1.2 times as many tags from large fish. Site-specific effort for all streams was 767 h/km for large fish and 1,056 h/km for small fish (Appendix L). Removing the effect of on-site effort resulted in relative returns of 48% for large fish and 29% for small fish on all streams combined. This difference was highly significant ($P = 0.01$).

Anglers rated fishing quality similarly ($P = 0.2$) in sections of Warm Springs Creek and Trail Creek stocked with large and small fish (Figure 6). Most fishermen contacted did not have tagged fish in possession, however. Ratings did differ among streams ($P < 0.005$). Fishing quality may have been related to stocking rates for unmarked fish (Figure 7).

Sixty-five percent of anglers interviewed on all streams ($N = 365$) said they preferred to catch one large fish instead of two small fish (Figure 8). This difference was highly significant ($P < 0.005$). The ratio of anglers preferring large fish was greatest on Trail Creek (2.4x), intermediate on the upper Wood River (1.7x), and least on Warm Springs Creek (1.5x). The probabilities that these differences were due to chance were negligible ($P < 0.005$, 0.04, and 0.02, respectively).

Angler Distribution

Eighty-six percent of anglers fished areas immediately adjacent to stocking sites on Warm Springs Creek (Table 2). About half of those fished a short stream segment at the lower end of the study area (Figure 9). Fewer fish were stocked at this regular site than other sites on Warm Springs Creek. It was not possible to stock this site directly with a hatchery vehicle. Fish were stocked by carrying a few netfulls to the stream (Doug Young, IDFG, personal communication). This appeared to be the first publicly-owned area where anglers could park adjacent to the stream as they drove up the Warm Springs road from Ketchum.

Most anglers (85%) also fished the vicinity of stocking sites on Trail Creek (Table 2). Stocking, access, and effort were concentrated in the small fish section (Figure 10). Anglers fished mostly the lowermost stocking site, which was again the first major public access along the Trail Creek road from Ketchum. This was a developed picnic area with parking and restroom facilities.

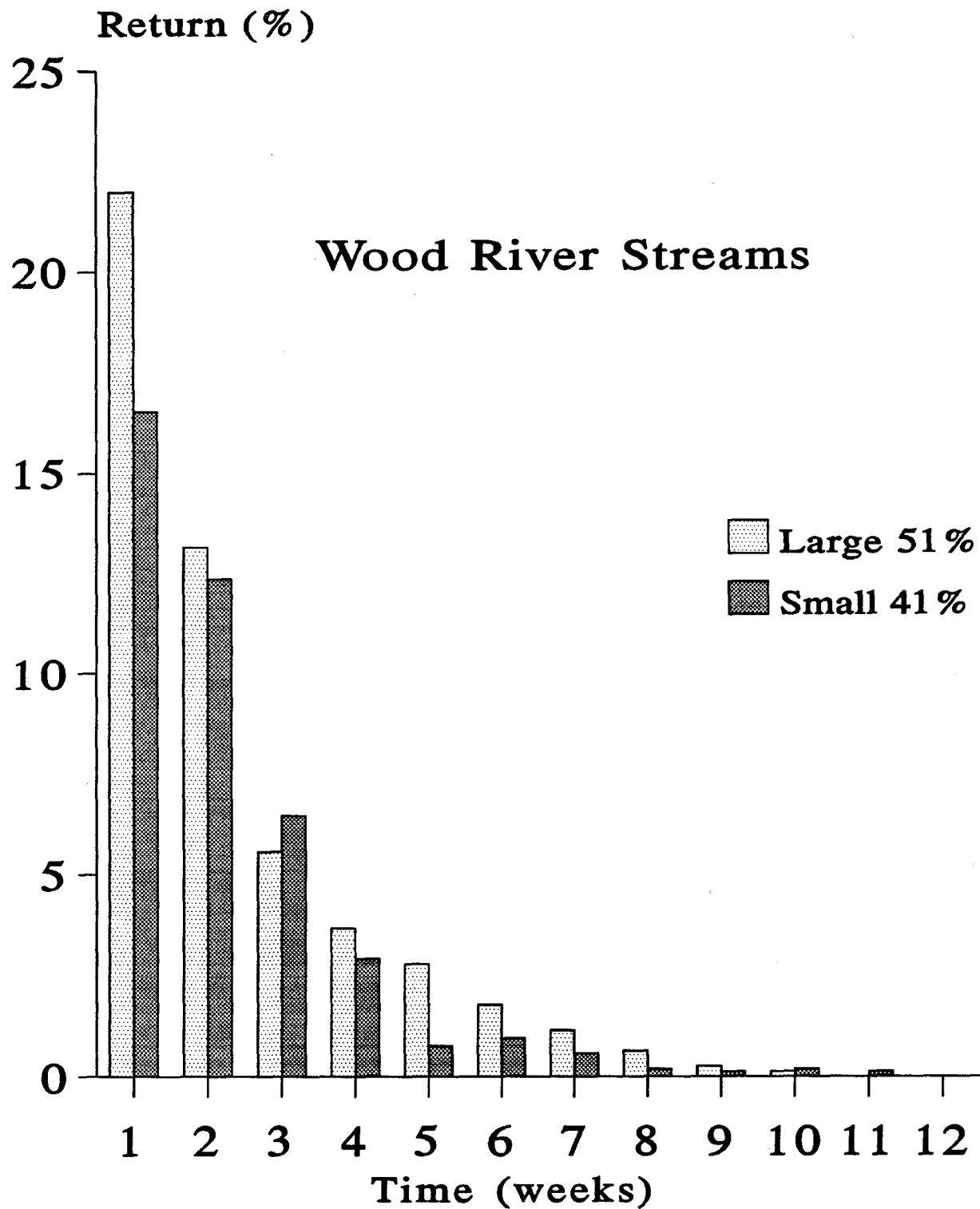


Figure 4. Weekly returns (%) of jaw tags from 30 cm and 24 cm put-and-take trout stocked in Wood River study streams in 1993.

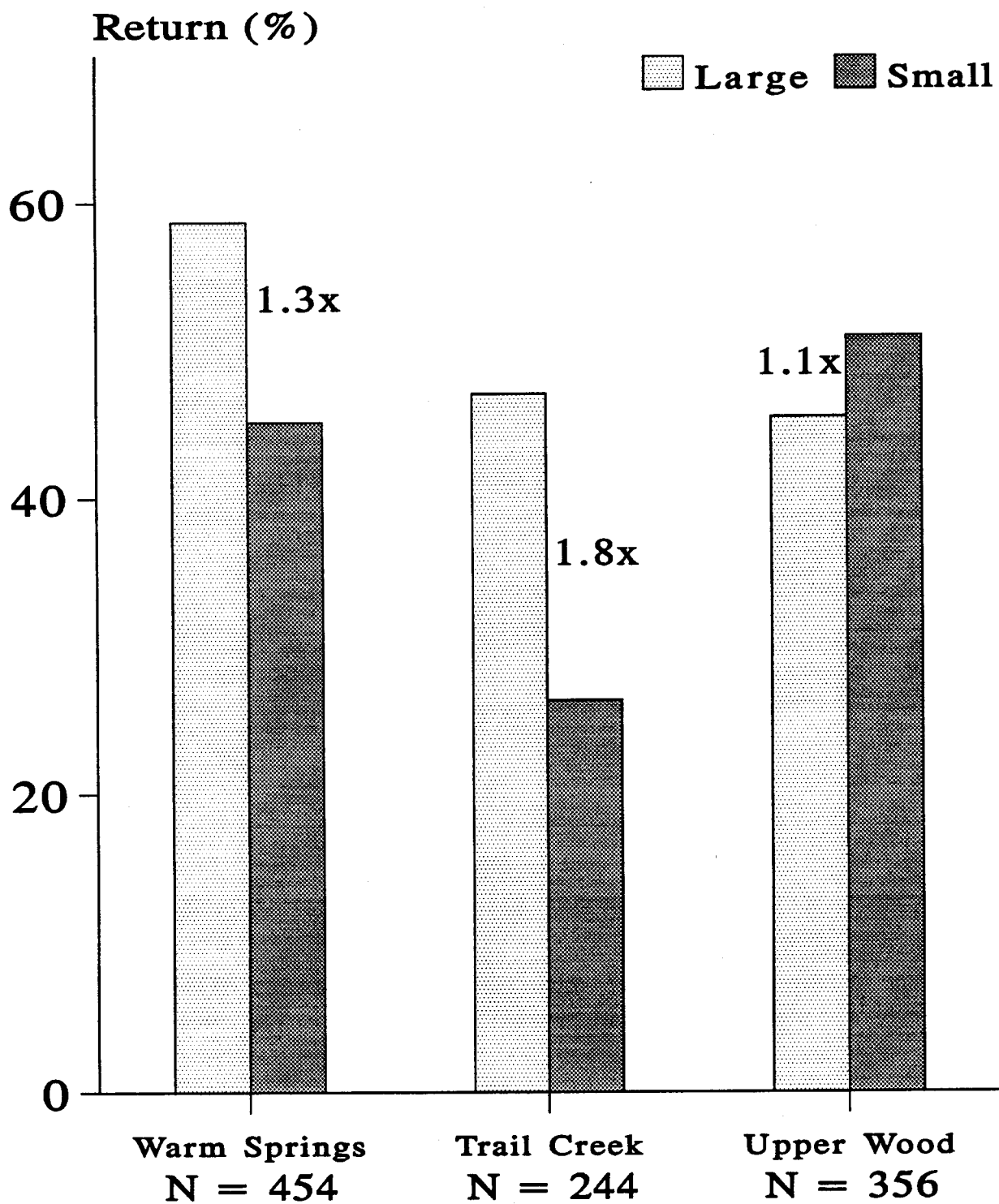


Figure 5. Ratios of jaw tag returns from 30 cm and 24 cm hatchery rainbow trout stocked in Wood River study streams in 1993.

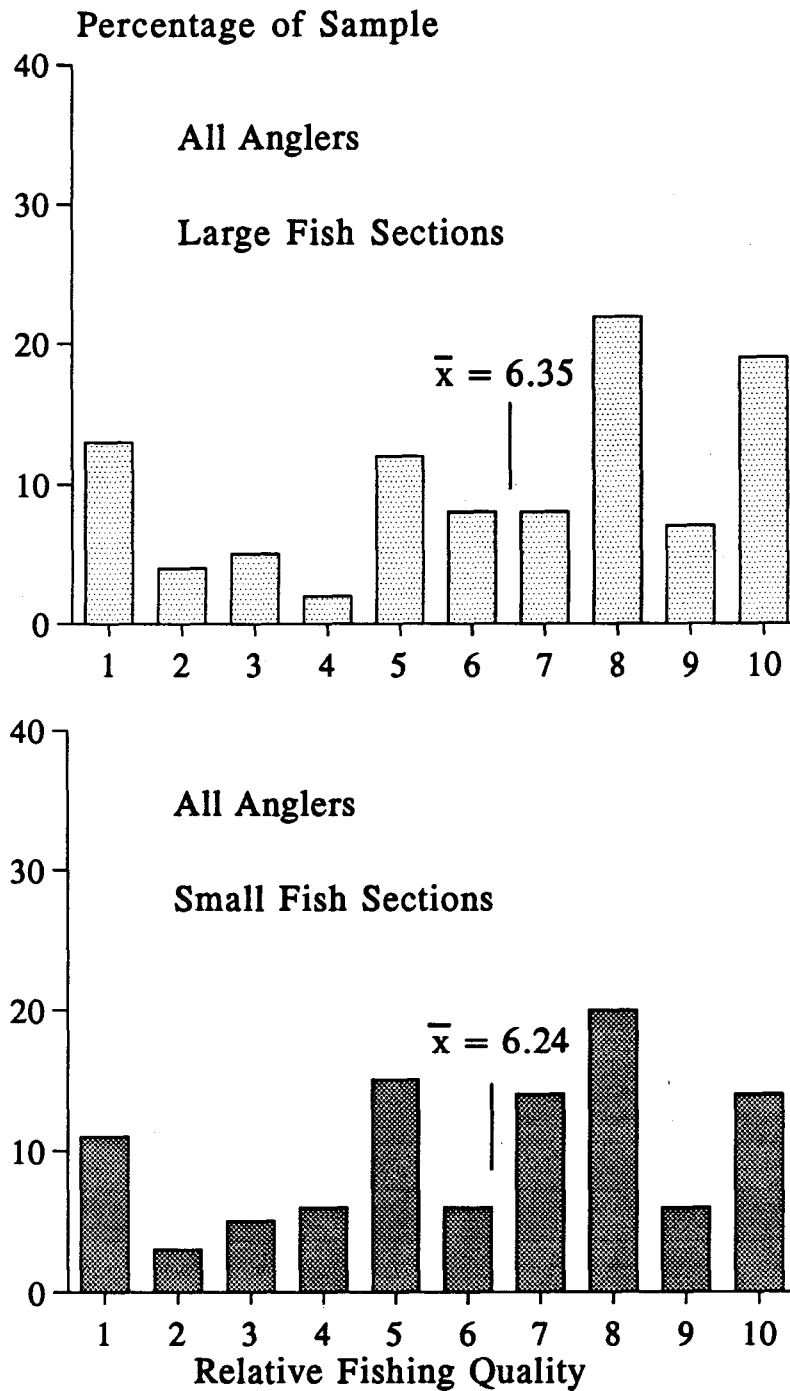


Figure 6. Angler ratings (1 = worst, 10 = best) of fishing quality on sections of Trail Creek and Warm Springs Creek stocked with marked put-and-take trout in 1993.

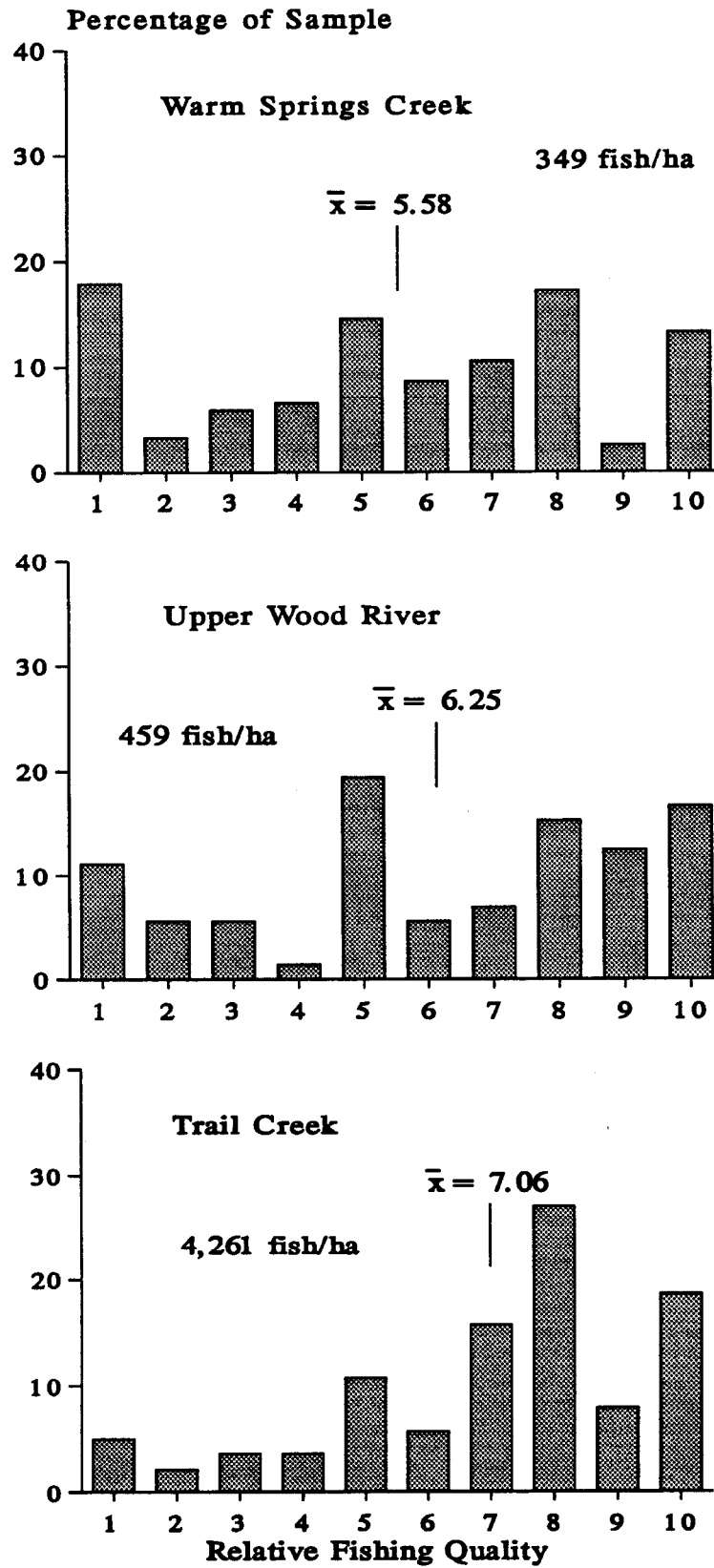


Figure 7. Angler ratings of fishing quality for Wood River study streams and corresponding stocking densities for unmarked hatchery rainbow trout (number per hectare).

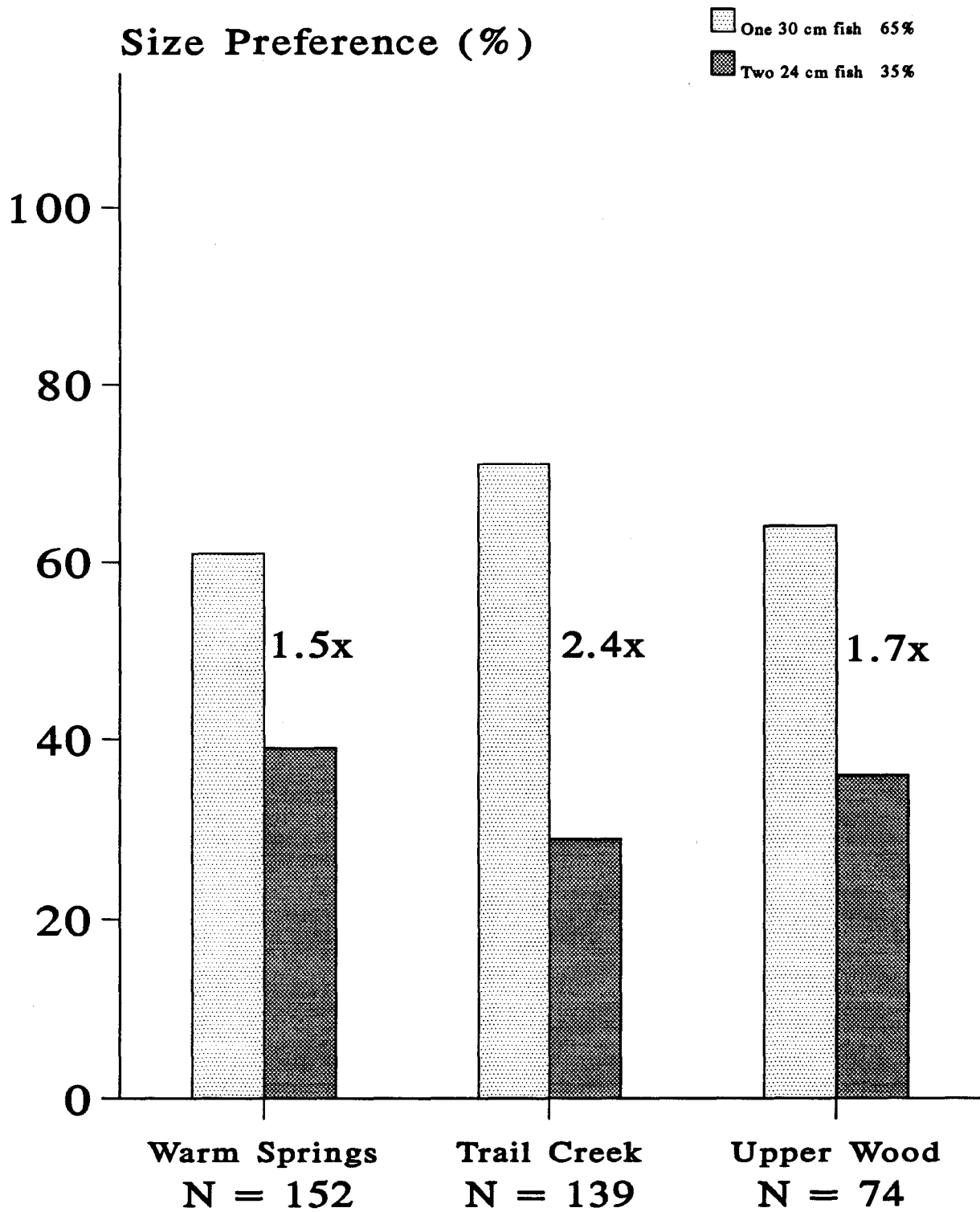


Figure 8. Preferences (%) for one 30 cm fish or two 24 cm put-and-take trout expressed by anglers fishing Wood River streams in 1993.

Table 2. Distribution of anglers (%) in relation to Wood River stream sites stocked with hatchery rainbow trout in 1993. Stocked areas were within 0.2 km of stocking sites.

Stream	Stocked Areas		Areas not adjacent to stocking sites
	Tag sites	Regular sites	
Warm Springs Creek N=291	19.9	66.3	13.7
Trail Creek N=238	16.8	67.6	15.5
Wood River N=139	12.2	36.7	51.1
Total N=668	17.2	60.6	22.2

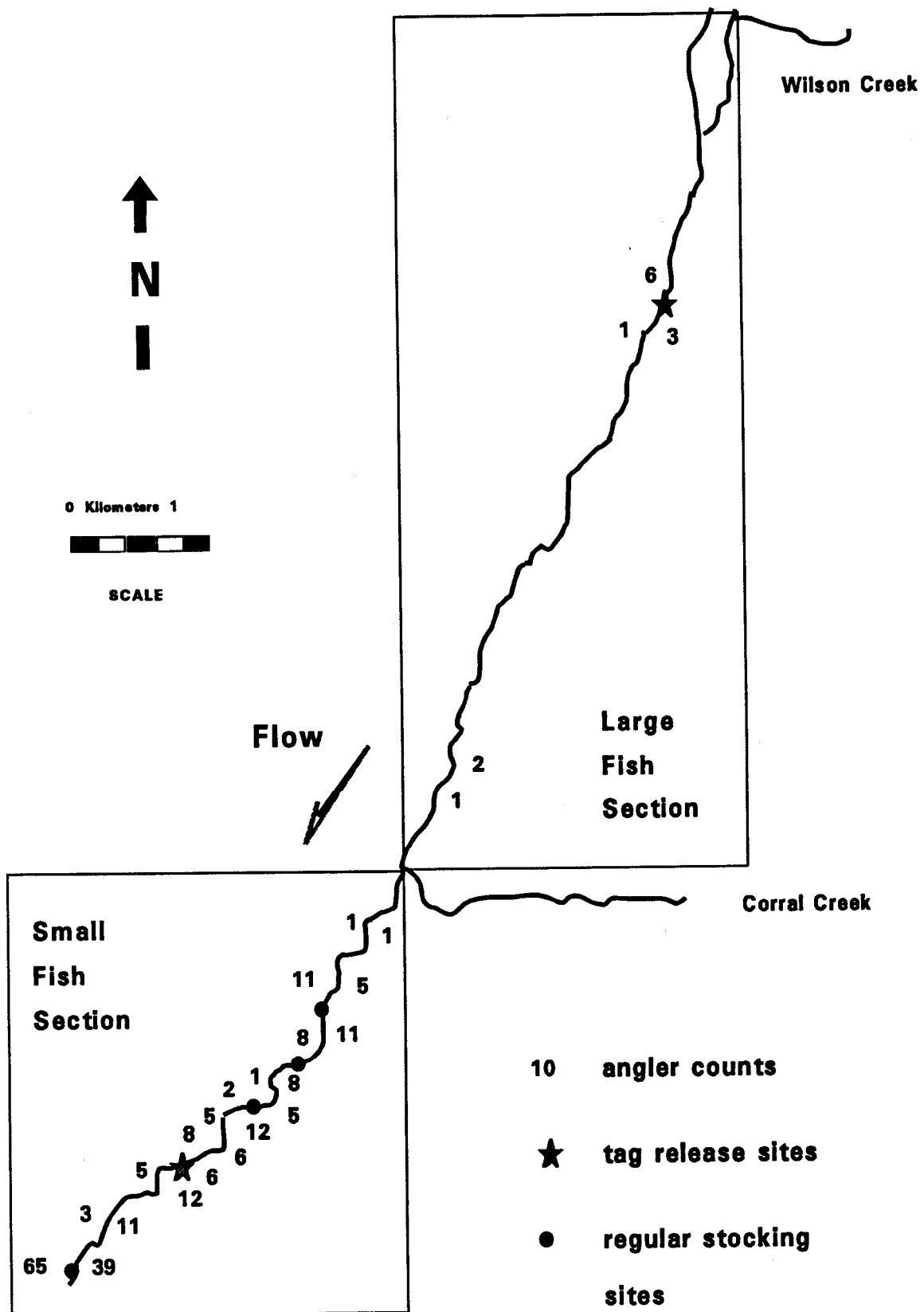


Figure 10. Map of Trail Creek showing angler distribution (N = 238) in relation to stocking sites.

The majority of anglers (51%) fished areas that were not immediately adjacent to stocking sites on the upper Wood River (Table 2). The lower end of the study area was fished most intensively. Some of that effort dispersed more than 0.2 km downstream of the stocking site (Figure 11). This portion of the stream was developed with resort and parking facilities.

For all streams combined, the majority (78%) of anglers fished within 0.2 km of stocking sites (Table 2). Angler concentrations were greatest at the downstream boundaries of study streams. These were the first fishable areas anglers traveling from Sun Valley could park near (Figures 9-11).

Hook Size

Bait fishermen used mostly size 6-10 hooks on Wood River streams (Figure 12). Harvest rates were highest for anglers using size 10 hooks. Fly fishermen used mostly size 12 and smaller hooks on Wood River streams (Figure 13). Harvest rates of over 3.0 fish/h were greatest for size 8 hooks.

On Gavers Lagoon, most anglers fishing with bait used size 6-12 hooks. Size 6 hooks were used most frequently followed by progressively fewer anglers using smaller hooks (Figure 14). Catch rates for the same fishermen show an increasing trend with smaller hooks. Relatively few anglers fished Gavers Lagoon with lures and flies. Lure sample size (N = 27) was too small to examine the relation between hooks and catch rates. Most fly fishermen used size 6-14 hooks (Figure 15). Success rates did not vary consistently to increase with hook size, but the small number of anglers interviewed (N = 53) limits the data.

DISCUSSION

Number and Size of Fish

The ratio of unadjusted large:small returns from Wood River streams did not approach those from Rock Creek in 1991 (Mauser 1992). This could have resulted from the narrower range of sizes stocked in Wood River streams or from other factors. If Wood River streams were fished more intensively than Rock Creek in 1991, the result might be relatively high returns, but less difference between sizes. Site-specific effort was not measured on Rock Creek. Also, since angler counts were not structured in this study, total effort may not be comparable to Rock Creek or other streams. I used unstructured counts only for paired comparisons, assuming biases were similar for different sections of the same stream.

Adjustments for angling effort between sections did not modify basic size effects. Effort has been recognized as the primary determinant of put-and-take trout harvest (Cooper 1959). Since the actual shape of the relationship between effort and return rates is not known for these streams, the validity of my attempt to standardize for effort is questionable, however. Adjusted rates

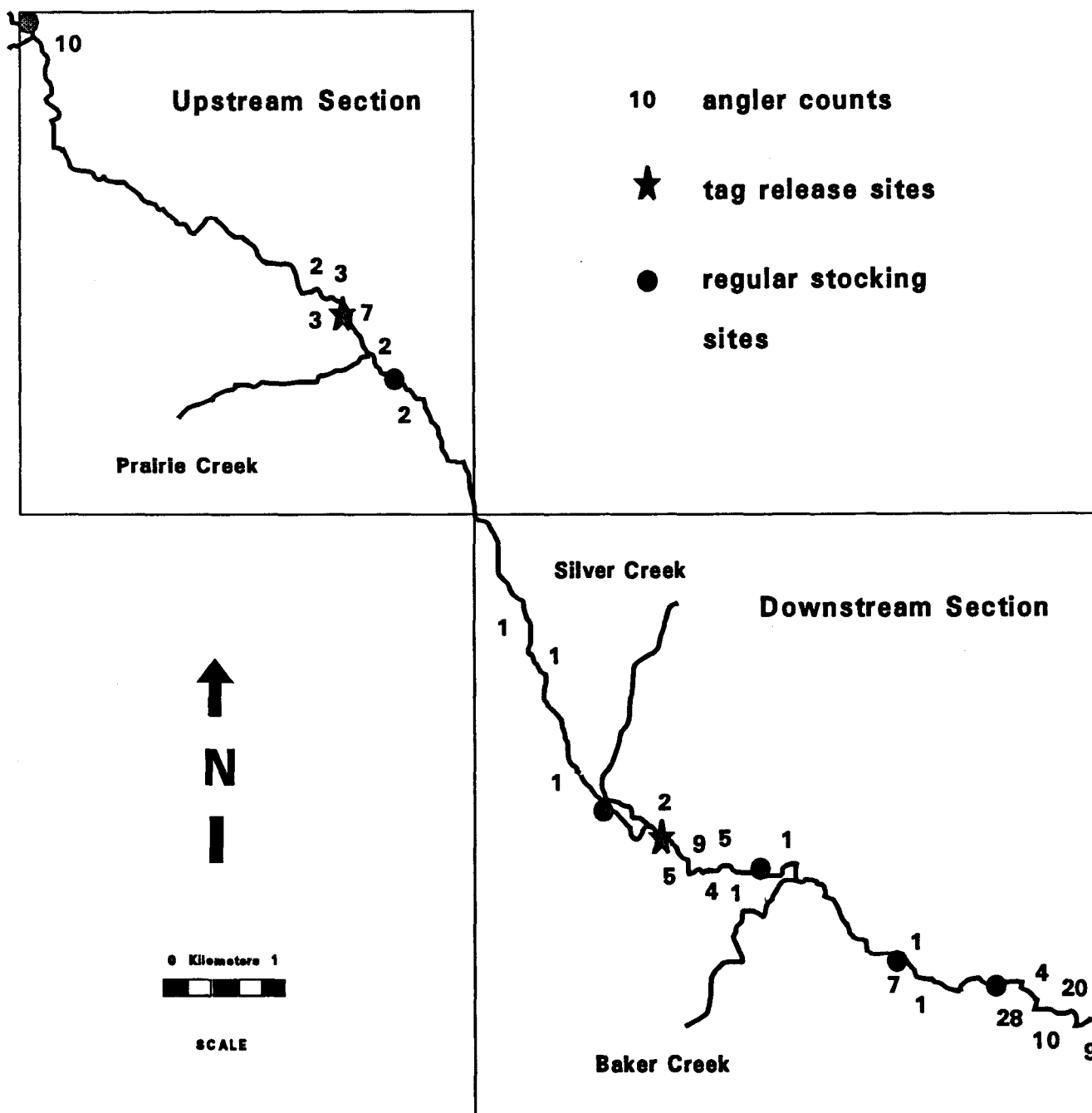


Figure 11. Map of upper Wood River showing angler distribution (N = 139) in relation to stocking sites within study sections.

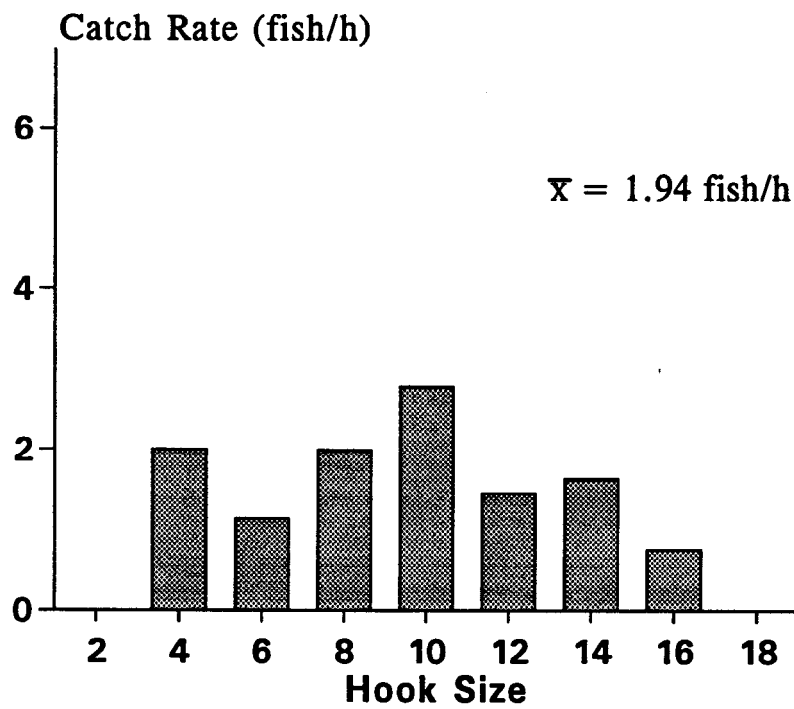
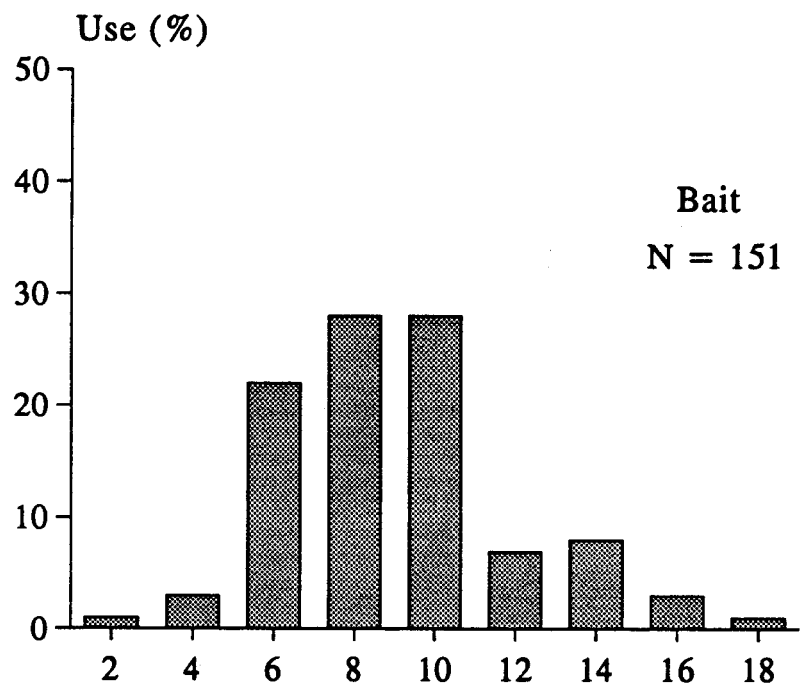


Figure 12. Hook sizes used (%) by anglers fishing with bait, and catch rates (fish per hour) in relation to hook size for Wood River streams in 1993.

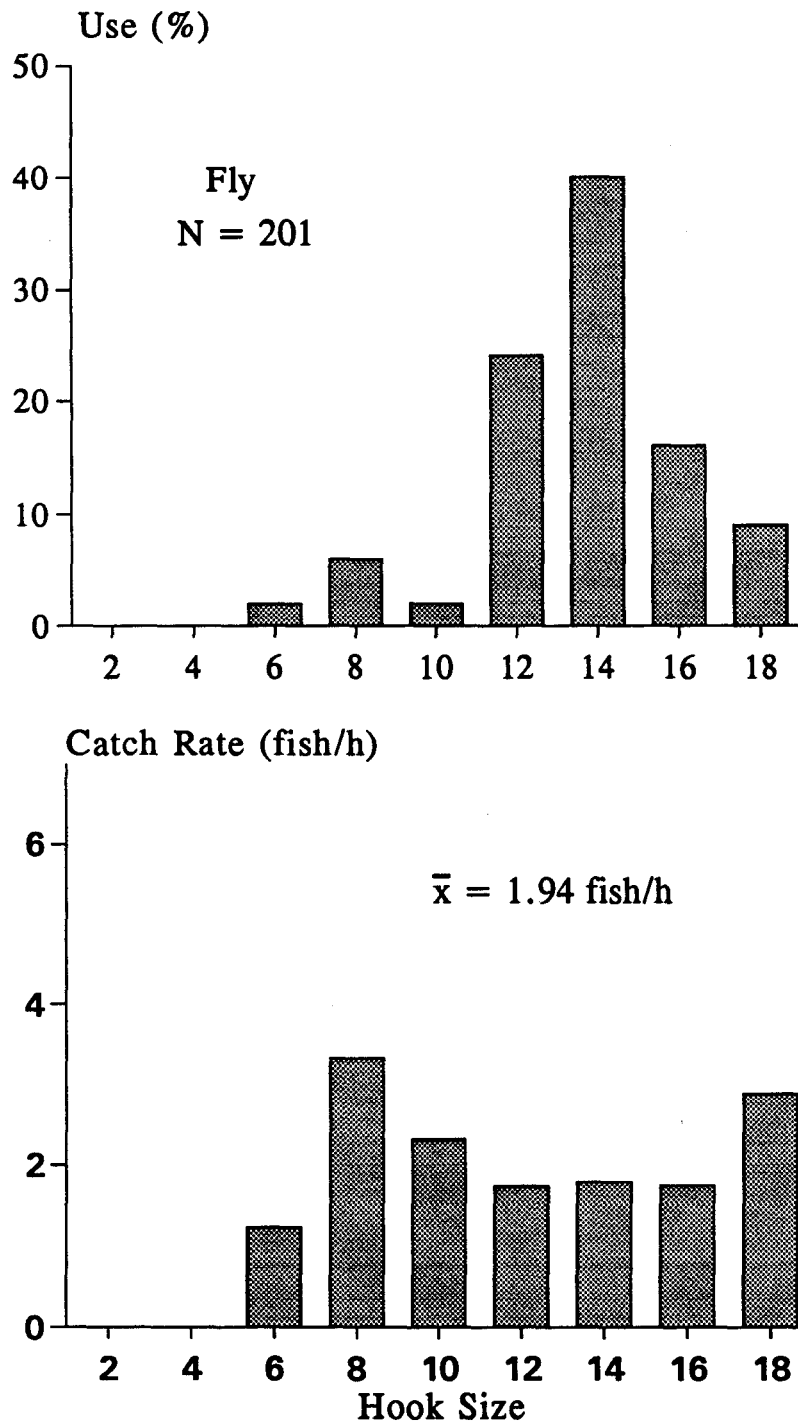


Figure 13. Hook sizes used (%) by anglers fishing with flies, and catch rates (fish per hour) in relation to hook size for Wood River streams in 1993.

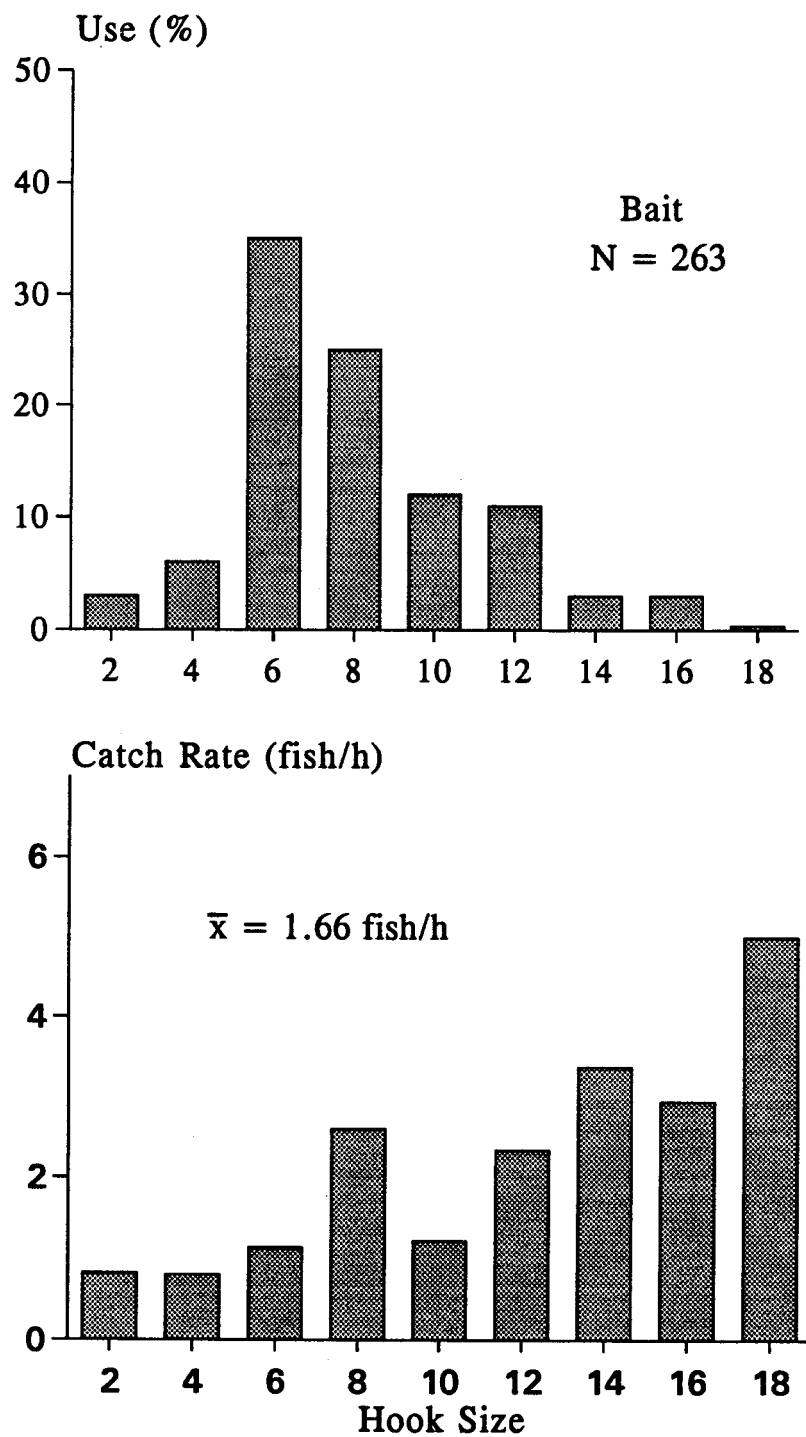


Figure 14. Hook sizes used (%) by anglers fishing with bait, and catch rates (fish per hour) in relation to hook size for Gavers Lagoon in 1993.

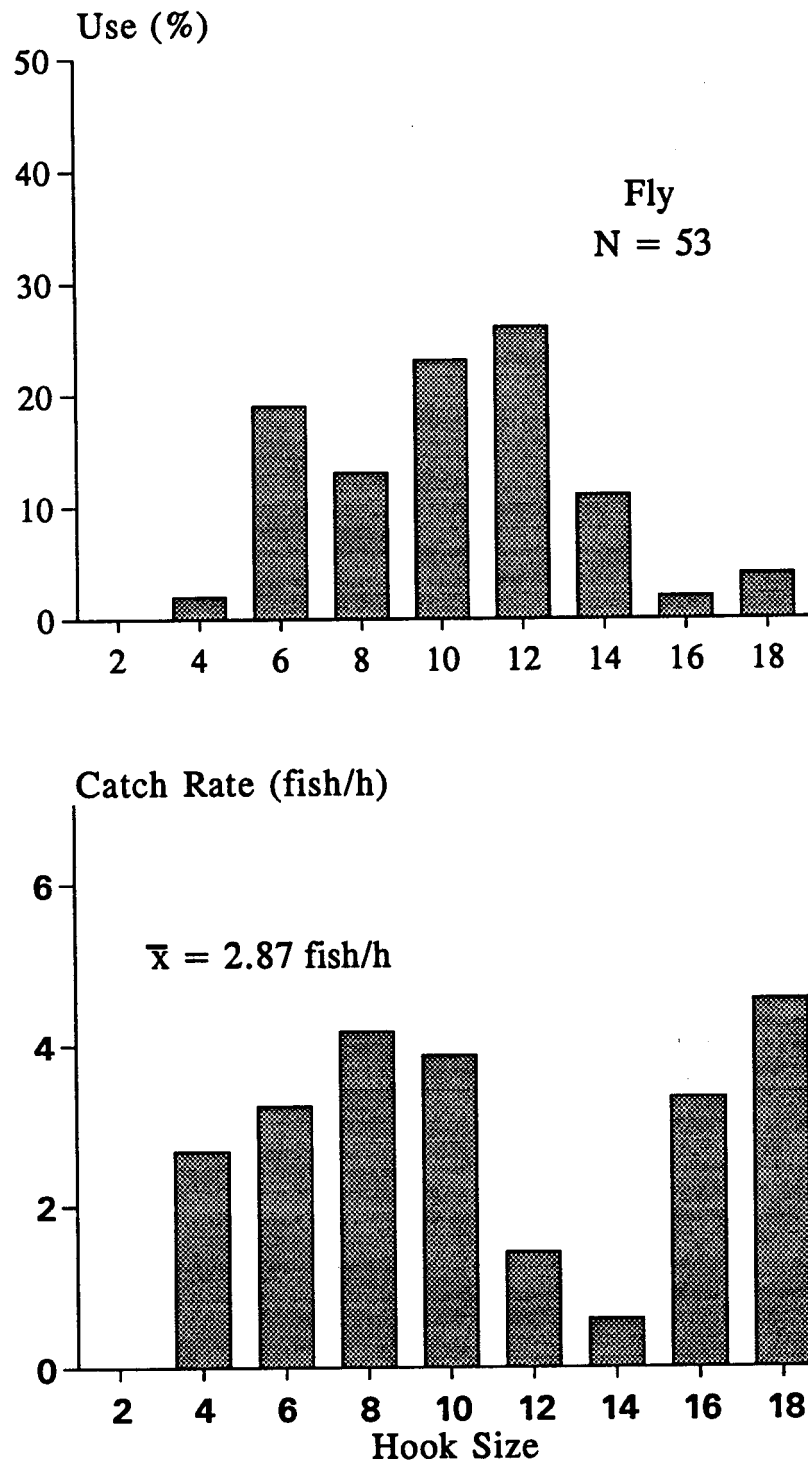


Figure 15. Hook sizes used (%) by anglers fishing with flies, and catch rates (fish per hour) in relation to hook size for Gavers Lagoon in 1993.

should, therefore, be used with caution. They are only a relative measure of effort effects. Unless the relationship between effort and return is defined for the particular fishery involved, proper use of standardized rates is likely limited to a gross examination of the data for effort bias.

I used localized effort adjustments rather than total effort for large and small fish sections because work in Idaho has indicated hatchery fish remain concentrated near stream stocking sites (Mauser 1994). Since angler distribution was not uniform, fishing pressure for entire sections might not represent actual effort on marked fish. On-site effort explained relatively high returns of large fish from upper Trail Creek where overall effort was relatively low. I did not scatter fish throughout sections to equalize effort effects because I wanted to maximize returns and minimize mixing of marked fish of different sizes. Study streams were too small to separate sections with similar access, stream size, and gradient by adequate distances for scatter stocking.

Catchability of larger fish may be better than indicated by total return-to-creel. On Warm Springs Creek, on-site angling was more intense for small fish yet returns of large fish were greater. In most cases, small fish also were harvested after spending more time in streams than large fish. More rapid harvest and better returns at lower effort may be the result of size-related catchability. More catchable fish are harvested first even where effort is high enough to remove most of the fish present (Cooper 1959). High levels of effort may limit the utility of stocking larger fish if total returns are the only performance criteria.

On-site tag boxes should have increased tag return rates compared to Rock Creek where anglers had to mail tags. This would affect large and small return comparisons in the two studies if, for example, anglers were less likely to return tags from small fish when they had to mail them. Nonresponse bias may have been greater for small fish on Rock Creek but I was not able to separate it from other potential effects such as possible lower survival or catchability of smaller fish due to marking and handling (Mauser 1992). I did not detect size-related bias in angler response rates for Wood River streams. Tag box locations probably were not identical with respect to ease of returning tags though every attempt was made to equalize or offset differences within streams.

A key assumption for valid comparisons is that marking procedures have similar effects on experimental groups. Tagging and handling stress can affect smaller fish more adversely. Cunningham and Anderson (1992) found mortality associated with transportation and stocking was not size-dependent in a lake. Kennedy et al (1982) found mortality was greater for smaller fish tagged with plastic smolt (Carlin) tags and stocked in ponds. Isaksson and Bergman (1978) concluded increased survival with fish size can be an artifact of Carlin tags. Harvest estimates on Rock Creek indicated untagged small fish returned at greater rates than jaw-tagged small fish (Mauser 1992). If smaller fish are more affected by tagging and handling, differences in return rates based on tagging studies may not be real.

Though tagging and handling stress certainly occurred, I found no indication it altered size comparisons in this study. Tag return patterns supported the overall conclusion that larger fish were inherently more catchable. The upper

Wood River was an exception where differences in fishing effort may have determined the timing of returns. I believe these results were also inconsistent with size-related stress. Large fish also returned later than small fish in Trail Creek. The effect, if any, of handling stress apparently was not consistent with size. That may not always be the case. We handled fish similarly in both Rock Creek and Wood River experiments yet Rock Creek returns showed tagging bias. Effects may be greater where tested differences are more pronounced as they were at Rock Creek.

Another limitation to return rate comparisons is angler sorting and selective release of smaller fish. We did not evaluate the extent to which anglers, particularly accomplished fishermen, released fish and the subsequent effect on tag returns. Significant size selection by anglers could also negate basic conclusions about catchability in relation to size and may require additional consideration. Rohrer (1990, 1991) reported anglers released 50%-66% of put-and-take trout caught in the Middle Fork Boise River. Release rates were higher when smaller fish were stocked (4/lb vs 3/lb). Anglers in our study also may have removed and returned tags from released fish.

Size-related returns have not differed enough to justify stocking only larger fish in streams. It would appear we could maintain returns on Wood River streams by stocking 30 cm fish at 81% of present rates. However a 50% reduction in numbers would be necessary to offset increased production costs. Though larger fish may increase total angler satisfaction with the fishery, not all anglers preferred them with the tradeoff in numbers. Also larger fish may not always return at *higher* rates. Information from the upper Wood River and other Idaho streams (Cuplin 1958) indicates small fish returns occasionally equal or exceed those of large fish.

Perhaps a blend of large and small fish would be useful to optimize angler satisfaction and hatchery rearing capacity. If we shifted production to 30 cm fish to the extent possible, we would still stock smaller trout in Idaho streams. Some Idaho hatcheries are unable to raise larger trout in quantity without extending rearing time and/or reducing loading beyond reasonable limits. Smaller fish also result from size variability in rearing. Stocking equal numbers of large and small trout would reflect a preference of half as many people for twice as many smaller fish. This may produce quality angling for the greatest number of people.

Anglers do have thresholds for numbers and size of fish for good fishing. Stocking fish below a certain size in put-and-take fisheries may be a waste of time. Information from Minnesota indicated rainbow trout had to be at least 21.5-23.0 cm long to be moderately acceptable to anglers. High release rates were attributed to the presence of fish of sizes that were not acceptable. Sorting and releasing fish, especially those caught on bait, may defeat the purpose of traditional put-and-take stocking programs (i.e. maximum harvest). Hirsch and Gates (1984) recommended that stocked fish be at least 23 cm long. Cochnauer and Schriever (1993) found tag return rates were seven times greater for 23-30 cm fish compared to fish smaller than 23 cm. I recommend we adopt the 23 cm minimum for fish stocked in Idaho streams for the purpose of providing put-and-take fishing. Future work could refine minimum requirements and evaluate production costs in relation to angler expectations.

Wood River anglers preferred larger fish by almost 2:1 despite the tradeoff in numbers necessary to provide them. Presently some Idaho streams are stocked with larger hatchery rainbow. If anglers generally prefer larger hatchery-reared fish, stocking them in other areas may increase total angler enjoyment despite the necessary reduction in numbers (Hirsch and Gates 1984). Wiechman (1990) concluded when trout abundance is adequate, biologists should focus on increasing size of fish available to anglers. I suspect minimum acceptable stocking rates would decrease with larger fish.

Most anglers we interviewed preferred fewer, larger fish even though fishing quality apparently increased with stocking rate on the same streams (Figure 7). Because anglers are typically more sensitive to changes in fish size than catch rates (Parkinson et al 1988), larger fish will probably attract anglers. Conversely, small fish may result in lower use and returns even if there are more stocked, simply because many anglers are not interested in them. We did not detect an overall pattern of increased use of larger fish on Wood River streams, but larger fish made up minor portions of total stocking.

The value of larger fish was not reflected in overall ratings of fishing quality in our test sections. Again, tagged fish may not have comprised enough of the harvest to influence angler ratings of fishing quality. With the low numbers of fish we were able to mark, I considered normal stocking necessary to maintain hatchery trout densities and angler use typical of the put-and-take program for these streams. The question we tried to answer was how stocking fewer, larger fish affects angler satisfaction. It would be necessary to replicate exclusive size management on a number of stream sections to firmly establish effects of fewer, larger fish on angling quality.

By contrast, return rate comparisons should be conducted in the same section to get the best results. Effort is only one of the factors unique to each stocked area. Greater numbers of tests would allow comparisons of additional factors such as stream size. Though it may not be possible to adequately describe all influences, factors that affect catchability and returns should be measured with more replications under the same circumstances.

Angler Distribution

The use of interviews rather than counts to determine angler distribution was not intended. Interviewers could have biased results in this study by contacting more anglers on the lower portions of streams. Interviews were generally conducted after counts and an attempt was made to vary starting points. Due to relatively low numbers of anglers fishing each study section at any given time, census clerks were able to interview all fishermen present in most cases. For these reasons, I believe the information presented does describe angler distribution.

Most interviewed anglers fished in sight of roads, regardless of stocking. Certainly, our census missed anglers who fished reaches not visible from the road. Angler use of such areas could be checked in more comprehensive evaluations of angler distribution. We found little indication (parked cars)

that fishermen made use of these areas compared to more accessible sites, however.

Access is important in put-and-take fisheries. Streams in Iowa within 90 m of roads were fished harder than less accessible areas. This occurred despite a stated preference by 44% of surveyed anglers for fishing farther from roads. Increased access on several streams also resulted in increased use (Paragamian 1983).

From our work it appeared that in addition to nearby roads, parking could be a prerequisite to heavy use of stocked fish. This does not necessarily mean agencies should construct parking areas on streams currently stocked with put-and-take trout. Anglers fishing these areas may find other aspects of the fishing experience, such as relatively unspoiled surroundings, more important than high return rates and efficient hatchery fish management. It may mean that put-and-take programs should be increasingly limited to developed areas where returns meet minimum standards. Less developed streams should be managed for wild trout fishing (IDFG 1991). Angler surveys may be useful to arrive at the best combination of fishing opportunity in different areas of the State.

Information on where to catch hatchery trout still may have potential to improve fishing. Long-range management plans (IDFG 1991) call for increased use of publicity to direct anglers to hatchery fish. The fact that most anglers in this study fished relatively close to stocking sites may not preclude the use of more detailed information about trout stocking to direct effort. For example most of the effort we plotted on Wood River streams occurred in the downstream portions of study areas. Sometimes these sites were lightly stocked. It may be possible to increase overall harvest levels on these streams by directing people upstream to other stocked areas.

Stocking publicity may prove more or less effective than mapping angler distribution and adjusting stocking to match. Despite publicity on changes in the stocking program, Rohrer (1990) found only half the fishing effort on the heavily stocked, less roaded Middle Fork Boise River compared to the North Fork. The options of shifting use or stocking should both be evaluated for effects on effort and harvest of stocked trout.

Hook Size

Our work with hook size was preliminary and potentially confounded by variable angling proficiency. Family fishing on ponds like Gavers Lagoon may involve less experienced anglers who happen to use larger hooks. Additional work may be necessary to remove angler skill effects. If smaller hooks do produce better catch rates in put-and-take fisheries, education at areas fished by family groups or casual anglers would presumably be most beneficial. Fishery biologists rarely get an opportunity to double or triple angler harvest rates with negligible program costs; these relationships should be investigated further.

RECOMMENDATIONS

1. Adopt a minimum acceptable size of 23 cm for put-and-take trout stocked in Idaho streams and evaluate. Grade off and rear smaller fish to larger size before stocking, or stock in put-and-grow waters.
2. Evaluate localized use by mapping angler distribution. Adjust stocking locations accordingly.
3. Evaluate effectiveness of site-specific publicity to increase angler harvest of put-and-take trout in streams. Stock test and control fish together for return-to-creel evaluations. Stock fish in separate areas for size-related quality evaluations but use numbers representative of hatchery production capabilities.

ACKNOWLEDGEMENTS

I would like to thank Bob Esselman, Doug Young, Brian Malaise, and Mike Paddock for their help and cooperation at Hayspur Fish Hatchery. Tom Ashbeck and JoHanna Goetsch conducted angler counts and interviews. Aileen Goetsch organized, entered, and proofed data.

LITERATURE CITED

- Bailey, R.E. 1974. Development of recommendations for efficient use of catchable trout in West Virginia (Part I). Master of Science Thesis. Virginia Polytechnic Institute. Blacksburg.
- Butler, R.L., and D.P. Borgeson. 1965. California "catchable" trout fisheries. California Department of Fish and Game Bulletin 127. Sacramento.
- Cochnauer, T., and E. Schriever. 1993. Regional fisheries management investigations. Idaho Department of Fish and Game Job Performance Report F-71-R-15. Boise.
- Cooper, E.L. 1959. Trout stocking as an aid to fish management. Pennsylvania Agricultural Experiment Station Bulletin 663. University Park.
- Cunningham, P.K., and C.S. Anderson. 1991. Effect of size at stocking on harvest of rainbow trout in Bad Medicine Lake. Minnesota Department of Natural Resources Investigation Report 421. St. Paul.
- Cuplin, P. 1958. The survival of planted trout to the creel as related to their size and time of planting. Idaho Department of Fish and Game Job Performance Report F-32-R-1. Boise.
- Fleiss, J.L. 1981. Statistical methods for rates and proportions. John Wiley and Sons. New York.
- Hirsch, S., and L. Gates. 1984. A quantitative and qualitative creel census on Mazeppa Creek and Hay Creek and related Management implications for 1983. Minnesota Department of Natural Resources Completion Report F-29-R-3. St. Paul.
- Hulbert, P.J., and R. Engstrom-Heg. 1980. Hooking mortality of worm-caught hatchery brown trout. New York Fish and Game Journal 27: 1-10.
- Idaho Department of Fish and Game. 1991. Fisheries management plan 1991-1995. Boise.
- Isaksson, A., and P.K. Bergman. 1978. An evaluation of two tagging methods and survival rates of different age and treatment groups of hatchery-reared Atlantic salmon smolts. Journal of Agricultural Research in Iceland 10:74-99.
- Kennedy, G.J.A., C.D. Strange, and G.O. O'Neill. 1982. Tagging studies on various age classes of brown trout (Salmo trutta L.). Fisheries Management 13: 33-41.
- Kirby, K.N. 1993. Advanced data analysis with SYSTAT. Van Nostrand Rienhold. New York.

- McArthur, T.J. 1993. Statewide angler opinion and harvest surveys, creel census system. Idaho Department of Fish and Game Job Completion Report F-73-R-15. Boise.
- Matlock, G.C., H.R. Osburn, R.K. Riechers, and R.B. Ditton. 1991. Comparison of response scales for measuring angler satisfaction. American Fisheries Society Symposium 12:413-422. Bethesda, Maryland.
- Mauser, G. 1992. Put-and-take stocking relations, Rock Creek size experiment, Salmon River census. Idaho Department of Fish and Game Job Performance report F-73-R-14. Boise.
- Mauser, G. 1994. Hatchery trout evaluations. Idaho Department of Fish and Game Job Performance Report F-73-R-15. Boise.
- Mullan, J.W. 1956. The comparative returns of various sizes of trout stocked in Massachusetts streams. The Progressive Fish-Culturist 18: 35-38.
- Orsi, J.A. 1987. Small versus large trolling lures for sampling juvenile chinook salmon and coho salmon. Transactions of the American Fisheries Society 116:50-53.
- Paragamian, V.L. 1983. Physical inventory of trout streams and survey of trout angler attitudes. Iowa Conservation Commission Completion Report F-89-R-4. Des Moines.
- Parkinson, E.A., J. Berkowitz, and C.J. Bull. 1988. Sample size requirements for detecting changes in some fisheries statistics from small trout lakes. North American Journal of Fisheries Management 8:181-190.
- Potter, B.A., and B.A. Barton. 1986. Stocking goals and criteria for restoration and enhancement of cold-water fisheries. In R.H. Stroud (ed.) Fish Culture in Fisheries Management: 147-159. American Fisheries Society. Bethesda, Maryland.
- Ralston, S. 1990. Size selection of snappers (Lutjanidae) by hook and line gear. Canadian Journal of Fisheries and Aquatic Sciences 47: 696-700.
- Rohrer, R.L. 1987. Harvest of planted rainbow trout of catchable size from five reaches of Henry's Fork, Idaho. North American Journal of Fisheries Management 7: 142-144.
- Rohrer, R.L. 1990. Upper Boise River basin fisheries investigation. Idaho Department of Fish and Game Job Performance Report F-73-R-12. Boise.
- Rohrer, R.L. 1991. Upper Boise River basin fisheries investigation. Idaho Department of Fish and Game Job Performance Report F-73-R-13. Boise.
- Spencer, P.D., and G.R. Spangler. 1992. Effect that providing fishing information has on angler expectations and satisfaction. North American Journal of Fisheries Management 12: 379-385.

- Wiechman, J.D. 1990. Evaluation of fishing quality indices and sizes of brown trout preferred by anglers in southeast Minnesota. Minnesota Department of Natural Resources Investigation Report 403. St. Paul.
- Wilkinson, L. 1990. SYSTAT: The system for statistics. SYSTAT, Inc. Evanston, Illinois.
- Zar, J.H. 1984. Biostatistical analysis, 2nd edition. Prentice-Hall. Engelwood Cliffs, New Jersey.

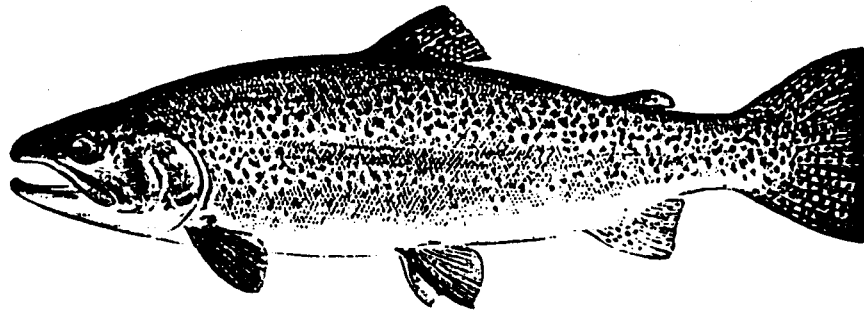
A P P E N D I C E S

Appendix A. Number and size of unmarked hatchery rainbow trout stocked in Wood River study streams in 1993.

Stream	Date	Number	Total length (cm)	Total stocked distance (km) ^a	Mean width (m)	Stocking density (number/ha)
Warm Springs Creek	Jul 02	1,500	24.3			
	Jul 16	1,500	25.4			
	Aug 19	1,500	25.5			
Total		4,500	25.1	13.7	9.2	349
Trail Creek	Jul 08	1,500	25.4			
	Jul 23	1,500	25.4			
	Aug 13	1,500	24.9			
	Aug 27	1,500	27.2			
Total		6,000	25.8	2.2	6.4	4,261
Upper Wood River	Jun 07	1,000	23.1			
	Jul 02	2,527	24.0			
	Jul 16	2,311	26.1			
	Aug 04	200	25.4			
	Aug 06	1,800	23.9			
	Sep 03	2,000	26.8			
Total		9,838	25.0	18.8	11.4	459
Grand Totals		20,338	25.2	34.7	10.3	569

^a Includes distances between stocking sites.

Appendix B. Tag return instructions attached to boxes at stocking sites on three streams in the Wood River drainage in 1993.



We have stocked jaw-tagged rainbow trout in this area as part of a program to improve fishing.

You can help by removing tags from fish you keep and placing tags in envelopes provided.

You can also evaluate fishing quality (see questions).

Lift top for envelopes and pencils.

Please return envelopes here.

Thank you for your help.



ANGLERS



These waters contain
jaw-tagged rainbow
trout.

Please return tags
in envelopes provided
and place in box at

Thank you for your
help in making better
fishing.

Appendix D. Angler counts and estimated angling effort (hours) for censused sections of Warm Springs Creek in 1993.

Interval	Dates	Downstream section					Estimated effort(h)	Upstream section					Estimated effort(h)
		Number of counts		Mean count		Estimated effort(h)		Number of counts		Mean angler count			
		Weekday	Weekend	Weekday	Weekend			Weekday	Weekend	Weekday	Weekend		
1	07/17-07/23	0	3	nc	1.67	50	0	3	nc	2.33	70		
2	07/24-07/30	1	3	2.00	5.00	302	1	3	3.00	0.33	237		
3	07/31-08/06	5	3	4.20	1.67	338	2	3	6.00	0.67	436		
4	08/07-08/13	3	4	1.33	2.75	169	2	2	1.00	2.00	126		
5	08/14-08/20	4	4	4.00	2.75	354	2	3	4.00	3.67	380		
6	08/21-08/27	0	4	nc	7.00	195	0	3	nc	2.33	65		
7	08/28-09/03	6	4	2.83	3.00	252	6	4	3.50	2.25	275		
8	09/04-09/10	6	2	0.67	0.50	52	6	2	0.67	0.00	33		
9	09/11-09/17	6	4	1.33	0.50	86	5	2	0.00	0.50	19		
10	09/18-09/24	2	4	1.00	1.25	97	2	4	1.00	1.00	88		
11	09/25-10/01	0	4	nc	0.25	9	0	4	nc	0.25	6		
Total counts		33	39				26	33					
Mean count				2.24	2.46				2.00	1.42			
Total hours						1,904					1,735		
Total hours/km						529					361		

Estimated Effort within 0.2 km of Stocking Sites						
Release	Dates	Large fish		Small fish		
		Total hours/release	Hours/site	Total hours/release	Hours/site	
1	07/15-16	1,904	346	1,735	661	
2	07/23	1,854	337	1,665	634	
3	07/29	1,552	282	1,428	544	
4	08/05	1,214	221	992	378	
5	08/12	1,045	190	866	330	
Mean hours	1,514	275	1,337	509		
Hours/km		421	688	279		1,274

Appendix E. Angler counts and estimated angling effort (hours) for censused sections of Trail Creek in 1993.

Interval	Dates	Downstream section				Estimated effort(h)	Upstream section				Estimated effort(h)
		Number of counts		Mean count			Number of counts	Mean angler count			
		Weekday	Weekend	Weekday	Weekend			Weekday	Weekend		
1	07/22-07/28	nc	3	nc	1.67	50	0	2	nc	0.00	10
2	07/29-08/04	2	3	2.00	0.67	171	1	2	2.00	0.50	297
3	08/05-08/11	6	2	0.50	0.00	35	6	4	4.33	2.25	352
4	08/12-08/18	4	2	1.50	2.50	174	7	2	3.57	6.00	480
5	08/19-08/25	2	4	2.00	0.00	139	3	5	6.33	4.80	518
6	08/26-09/01	2	3	0.00	0.67	19	0	3	nc	5.00	443
7	09/02-09/08	4	4	0.00	0.00	0	6	4	5.67	2.75	454
8	09/09-09/15	6	4	0.00	0.00	0	6	2	3.00	1.00	173
9	09/16-09/22	4	4	0.75	0.50	60	6	4	1.83	2.25	150
10	09/23-09/29	2	4	0.00	0.50	13	2	6	1.00	1.50	56
Total counts		32	33				37	34			
Mean count				0.63	0.55				3.70	2.71	
Total hours						661					2,933
Total hours/km						147					978

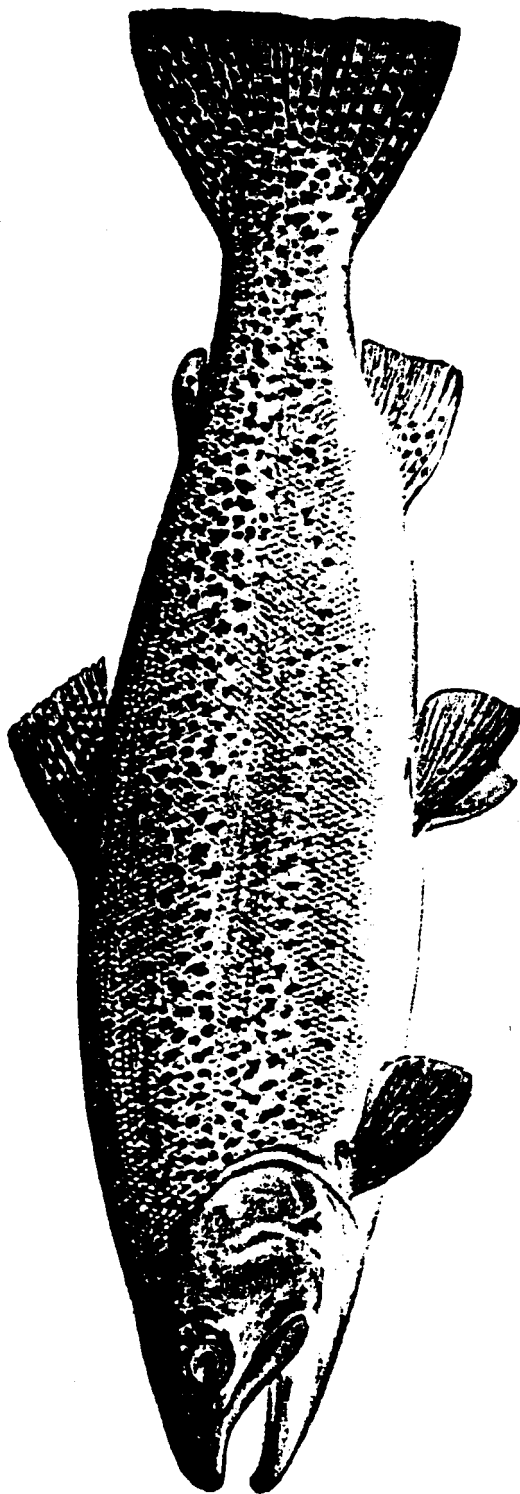
Estimated Effort within 0.2 km of Stocking Sites					
Release	Dates	Large fish		Small fish	
		Total hours/release	Hours/site	Total hours/release	Hours/site
1	07/22	661	508	2,933	548
2	07/28	611	470	2,923	546
3	08/04	440	338	2,626	490
4	08/11	405	312	2,274	424
Mean hours	529	407	2,689	502	
Hours/km		118	1,018	896	1,255

Appendix F. Angler counts and estimated angling effort (hours) for censused sections of the Upper Wood River in 1993.

Interval	Dates	Downstream section					Upstream section				
		Number of counts		Mean count		Estimated effort(h)	Number of counts		Mean angler count		Estimated effort(h)
		Weekday	Weekend	Weekday	Weekend		Weekday	Weekend	Weekday	Weekend	
1	07/20-07/26	0	1	nc	4.00	81	0	3	nc	0.00	0
2	07/27-08/02	1	3	1.00	1.33	76	1	2	0.00	0.00	0
3	08/03-08/09	2	3	1.50	0.00	104	2	1	0.00	0.00	0
4	08/10-08/16	4	1	1.75	10.00	317	3	2	0.00	1.50	42
5	08/17-08/23	3	3	1.67	2.00	172	3	2	1.33	0.00	93
6	08/24-08/30	0	2	nc	3.50	111	0	2	nc	1.00	28
7	08/31-09/06	5	3	1.40	6.67	323	5	3	2.80	4.00	275
8	09/07-09/13	5	2	1.40	1.50	41	4	4	0.25	2.00	88
9	09/14-09/20	6	4	1.17	0.50	92	6	4	1.00	0.00	63
10	09/21-09/27	2	6	0.00	0.67	19	2	4	0.00	0.00	0
Total counts		28	28				26	27			
Mean count				1.32	2.14				0.96	0.93	
Total hours						1,336					589
Total hours/km						196					103

Estimated Effort within 0.2 km of Stocking Sites					
Release	Dates	Large fish		Small fish	
		Total hours/release	Hours/site	Total hours/release	Hours/site
1	07/20	1,336	194	589	305
2	07/27	1,255	183	589	305
3	08/03	589	305	1,179	171
4	08/10	589	305	1,075	156
Mean hours		942	247	234	
Hours/km			147	135	586

Appendix G. Photocopy of rainbow trout print used to ask whether anglers preferred to catch one 30 cm fish or two 24 cm fish.



Appendix H. Weekly tag returns (unadjusted) for two size groups of hatchery rainbow trout stocked in Warm Springs Creek in 1993.

Size	Release group	Number stocked	Date	Tag Returns in Week												Total	Return (%)
				1	2	3	4	5	6	7	8	9	10	11	12		
Large	1	60	Jul 15	5	23	3	1	1	0	0	0	0	0	0	0	33	55.0
	2	61	23	34	4	3	0	0	0	2	0	0	0	0	0	43	70.5
	3	60	29	29	3	0	0	0	1	0	0	0	0	0	0	33	55.0
	4	61	Aug 05		16	16	2	2	1	1	0	0	0	0	0	38	62.3
	5	61	12	15	5	3	5	1	0	0	2					31	50.8
Total		303		99	51	11	8	3	2	2	2	0	0	0	0	178	
% Return				32.7	16.8	3.6	2.6	1.0	0.7	0.7	0.7	0.0	0.0				58.7
Small	1	122	Jul 16	21	10	6	9	1	4	0	1	0	1	0	0	53	43.4
	2	122	23	20	18	10	4	0	0	0	0	0	0	2		54	44.3
	3	122	29	22	23	10	1	0	1	0	0	0	1			58	47.5
	4	122	Aug 05	20	24	8	2	0	0	1	0	0				55	45.1
	5	122	12	38	8	3	5	2	0	0	0					56	45.9
Total		610		121	83	37	21	3	5	1	1	0	2	2	0	276	
% Return				19.8	13.6	6.1	3.4	0.5	0.8	0.2	0.2	0.0	0.3	0.3			45.2

Appendix I. Weekly tag returns (unadjusted) for two size groups of hatchery rainbow trout stocked in Trail Creek in 1993.

Size	Release group	Number stocked	Date	Tag Returns in Week											Total	Return (%)
				1	2	3	4	5	6	7	8	9	10	11		
Large	1	61	Jul 22	2	6	4	11	6	3	1	0	0	0	0	33	54.1
	2	61	28	5	3	14	3	5	3	0	0	0	0		33	54.1
	3	61	Aug 04	1	6	3	4	4	0	0	0	0			18	29.5
	4	61	Aug 11	24	4	1	1	0	0	0	1				31	50.8
Total		244		32	19	22	19	15	6	1	1	0	0	0	115	
% Return				13.1	7.8	9.0	7.8	6.1	2.5	0.4	0.4	0.0	0.0			47.1
Small	1	123	Jul 22	17	9	7	3	2	1	0	0	1	1	0	41	33.3
	2	122	28	14	10	3	2	0	0	1	0	0	0		30	24.6
	3	122	Aug 04	10	16	5	1	0	0	1	0	0			33	27.0
	4	121	Aug 11	15	4	4	0	0	2	0	0				25	20.7
Total		488		56	39	19	6	2	3	2	0	1	1	0	129	
% Return				11.5	8.0	3.9	1.2	0.4	0.6	0.4	0.0	0.2	0.2			26.4

Appendix J. Weekly tag returns (unadjusted) for two size groups of hatchery rainbow trout stocked in the upper Wood River in 1993.

Size	Release group	Number stocked	Date	Tag Returns in Week											Total	Return (%)
				1	2	3	4	5	6	7	8	9	10	11		
Large	1	61	Jul 20	6	14	4	2	3	4	1	2	2	0	0	38	62.3
	2	61	27	14	3	2	0	1	1	1	0	0	1		23	37.7
	3	61	Aug 03	14	11	4	0	0	0	4	0	0			33	54.1
	4	61	Aug 10	9	6	1	0	0	1	0	0				17	27.9
Total		244		43	34	11	2	4	6	6	2	2	1	0	111	
% Return				17.6	13.9	4.5	0.8	1.6	2.5	2.5	0.8	0.8	0.4			45.5
Smell	1	121	Jul 20	18	11	13	8	3	3	0	1	1	0	0	58	47.9
	2	121	27	28	19	4	4	3	2	4	0	0	0		64	52.9
	3	122	Aug 03	20	8	25	4	0	0	2	1	0			60	49.2
	4	117	Aug 10	18	35	4	3	1	2	0	0				63	53.8
Total		481		84	73	46	19	7	7	6	2	1	0	0	245	
% Return				17.5	15.2	9.6	4.0	1.5	1.5	1.2	0.4	0.2	0.0			50.9

Appendix K. Weekly tag returns (unadjusted) for two size groups of hatchery rainbow trout stocked in Wood River streams in 1993.

Size	Release group	Number stocked	Date	Tag Returns in Week												Total	Return (%)
				1	2	3	4	5	6	7	8	9	10	11	12		
Large	1	60	Jul 15	5	23	3	1	1	0	0	0	0	0	0	0	33	55.0
	2	183	20-23	42	24	11	13	9	7	4	2	2	0	0		114	62.3
	3	182	27-29	48	9	16	3	6	5	1	0	0	1			89	48.9
	4	183	Aug 3-5	31	33	9	6	5	1	4	0	0				89	48.6
	5	183	10-12	48	15	5	6	1	1	0	3					79	43.2
Total		791		174	104	44	29	22	14	9	5	2	1	0	0	404	
% Return				22.0	13.1	5.6	3.7	2.8	1.8	1.1	0.6	0.3	0.1				51.1
Small	1	122	Jul 16	21	10	6	9	1	4	0	1	0	1	0	0	53	43.4
	2	366	20-23	55	38	30	15	5	4	0	1	2	1	2		153	41.8
	3	365	27-29	64	52	17	7	3	3	5	0	0	1			152	41.6
	4	366	Aug 3-5	50	48	38	7	0	0	4	1	0				148	40.4
	5	360	10-12	71	47	11	8	3	4	0	0					144	40.0
Total		1,579		261	195	102	46	12	15	9	3	2	3	2	0	650	
% Return				16.5	12.3	6.5	2.9	0.8	0.9	0.6	0.2	0.1	0.2	0.1			41.2

Appendix L. Return rates for tagged rainbow trout stocked in Wood River streams in 1993.


Stream	Date	<u>Number stocked</u>		<u>Tag return</u>		<u>Unadjusted return rate</u>		<u>Site hours/km</u>		<u>Site adjusted return rate</u>	
		Large	Small	Large	Small	Large	Small	Large	Small	Large	Small
Warm Springs Creek	Jul 15-16	60	122	33	53	0.550	0.434	865	1,652	0.550	0.228
	23	61	122	43	54	0.705	0.443	843	1,586	0.705	0.235
	29	60	122	33	58	0.550	0.475	705	1,360	0.550	0.247
	Aug 5	61	122	38	55	0.623	0.451	552	945	0.623	0.263
	12	61	122	31	56	0.508	0.459	475	825	0.508	0.264
Total		303	610	178	276	0.587	0.452	688	1,274	0.587	0.247
Trail Creek	Jul 22	61	123	33	41	0.541	0.333	1,271	1,369	0.541	0.310
	28	61	122	33	30	0.541	0.246	1,175	1,364	0.541	0.212
	Aug 4	61	122	18	33	0.395	0.370	846	1,225	0.295	0.187
	11	61	121	31	25	0.508	0.207	779	1,061	0.508	0.152
Total		244	488	115	129	0.471	0.264	1,018	1,255	0.471	0.215
Upper Wood River	Jul 20	61	121	38	58	0.623	0.479	486	762	0.623	0.306
	27	61	121	23	64	0.377	0.529	456	762	0.377	0.317
	Aug 3	61	122	33	60	0.541	0.492	762	429	0.305	0.492
	10	61	117	17	63	0.279	0.538	762	391	0.143	0.538
Total		244	481	111	245	0.455	0.509	616	586	0.362	0.413
Grand total		791	1,579	404	650	0.511	0.412	767	1,056	0.482	0.288

Submitted by:

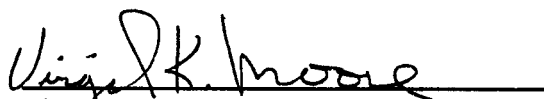
Gregg Mauser
Senior Fishery Research Biologist

Approved by:

IDAHO DEPARTMENT OF FISH AND GAME

A handwritten signature in black ink, appearing to read 'S. M. Huffaker', written over a horizontal line.

Steven M. Huffaker, Chief
Bureau of Fisheries

A handwritten signature in black ink, appearing to read 'Virgil K. Moore', written over a horizontal line.

Virgil K. Moore
Fisheries Research Manager